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CONTENTS

DEPARTMENTS

For complete table of contents see advertising page xxvii

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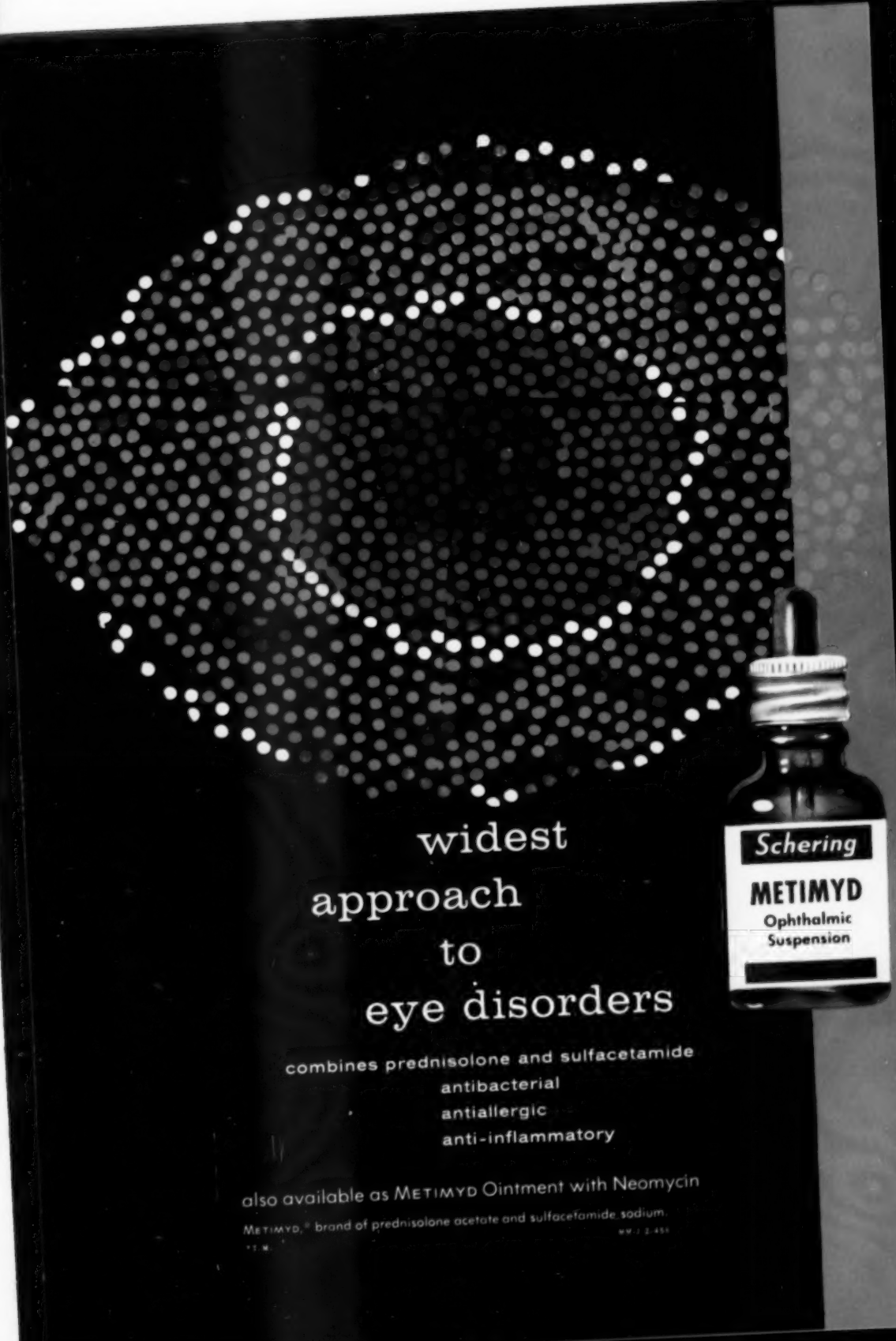
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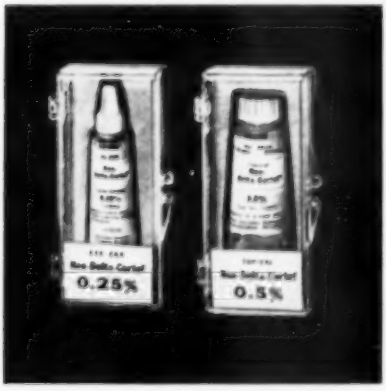

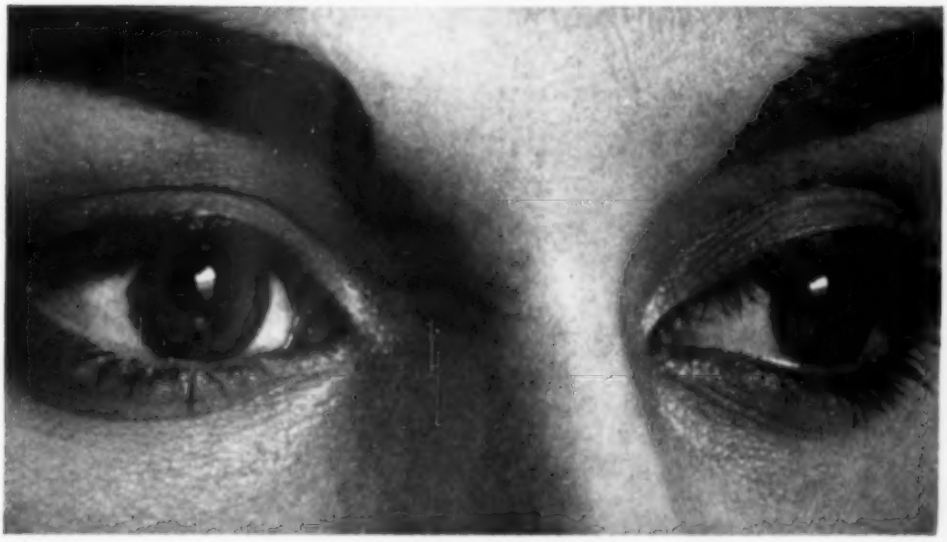

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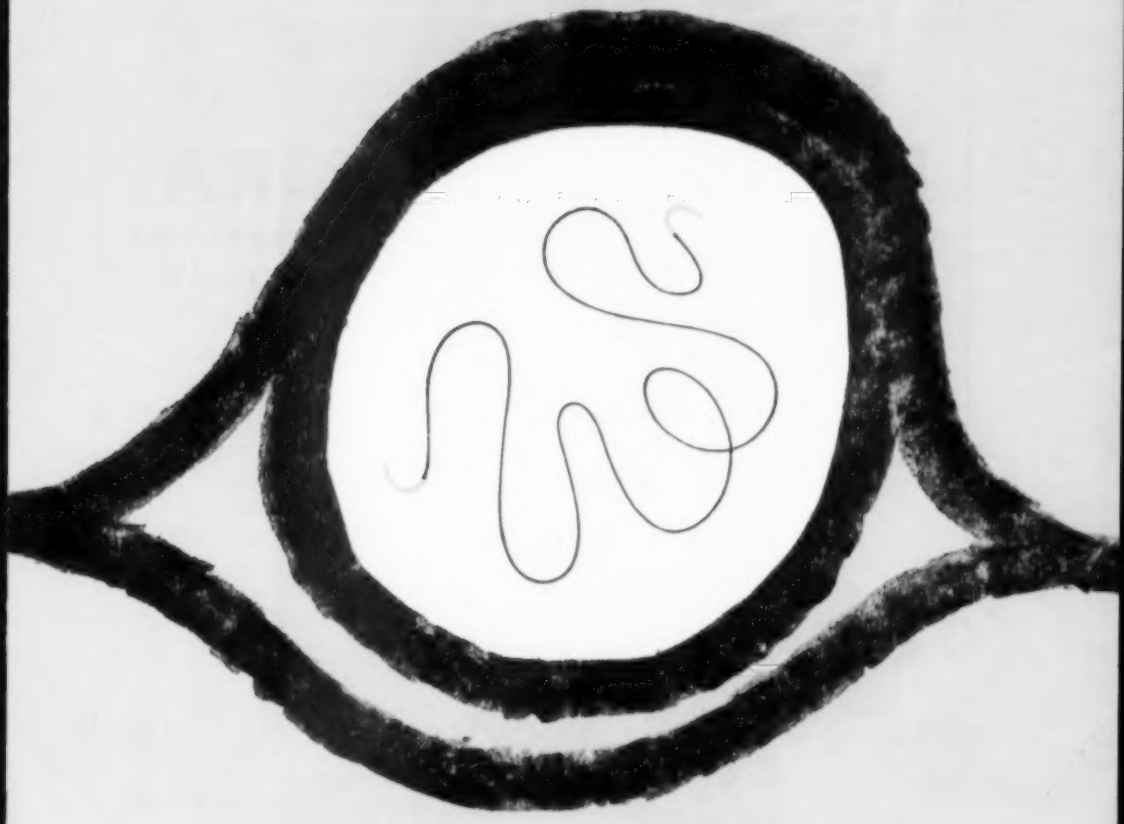

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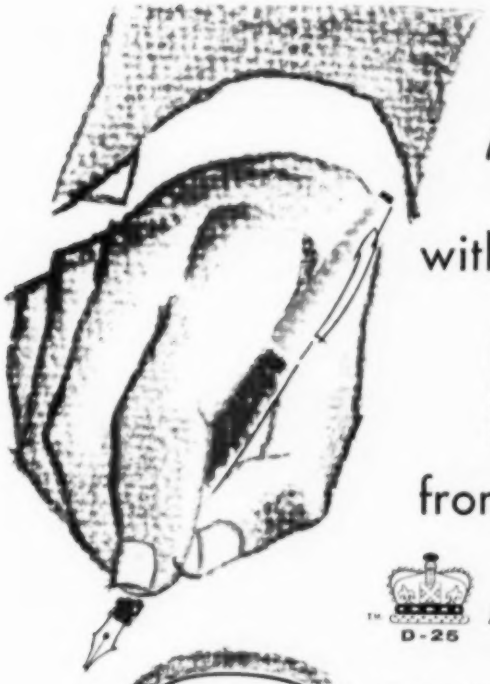

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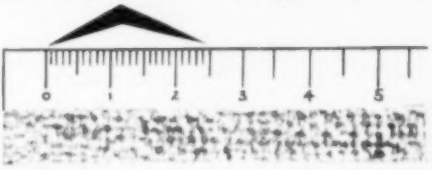

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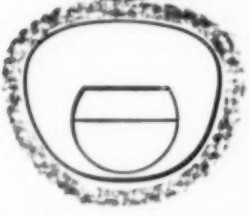

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CONTENTS

AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 42 OCTOBER, 1956 NUMBER 4, PART I

CENTRAL SEROUS RETINOPATHY*

CLINICAL AND EXPERIMENTAL STUDIES

MICHAEL I. WOLKOWICZ, M.D.
Philadelphia, Pennsylvania

Two unusual cases of central serous retinopathy, which came under my private care, were the stimuli to initiate further clinical and experimental studies of this puzzling condition.

In an historical review of the literature one is impressed both by the volume and also by the wealth of contradictory statements as to etiology, clinical course, and pathologic background. The textbook descriptions of central angiospastic retinopathy depict the condition as (1) affecting usually one eye, although rarely both eyes may be involved at the same time; (2) the course of the disease is usually toward recovery, although in severe cases it may last seven or eight months; (3) while the visual disturbance will disappear a small relative scotoma may persist.

The two cases which, I felt, might be of interest differ from this description in that they were bilateral, both eyes were simultaneously involved at one time or the other and the loss of central vision was permanent. In all other respects, the disease followed the classic descriptions. Therefore, when one reads the oft-repeated favorable prognosis for this condition by such authorities as Gifford, Marquardt, Duke-Elder, Elwyn, and others, one wonders if we are all speaking of the same entity.

HISTORICAL REVIEW

The first observation and clinical description of central serous retinopathy is credited to von Graefe[1] in 1866, although later reports tend to classify von Graefe's original observation as a case of relapsing central luetic retinitis. A number of papers on this subject began to appear in the Japanese literature after the first publication by Asayama in 1897. This was followed with contributions by Oguchi, in 1919, who expressed the belief that central serous retinopathy was caused by visible rays acting upon the sensitized retinal elements by photodynamic substances existing in the body. In line with his reasoning he called this entity "retinitis centralis photodynamica" pointing to the analogy existing between this condition and chorioretinitis centralis photodynamica produced in animals. Other investigators, however, like Kitahara[2] (1936), were inclined to consider it as a nonspecific tuberculous reaction (without epithelioid or giant cells) on the basis of positive tuberculin tests found in a large proportion of these patients.

One may argue that, since central serous retinopathy usually appears between the second and fourth decade, a positive tuberculin reaction in this age group loses much of its significance. Oguchi's observations received experimental support when Hei-u Ko[3,4] in 1933-34 produced in rabbits a circumscribed retinal edema closely resembling central serous retinopathy. Ko's technique, which is the point of departure of my laboratory investigations, will be described with more

* From the Wills Eye Hospital, service of Dr. P. Robb McDonald, and the Research Department, Wills Eye Hospital, Dr. Irving H. Leopold, director.

detail in connection with my experimental work.

Horniker,[5] who, in 1927, published 17 cases of central serous retinopathy, was first to stress the analogy to intermittent claudication, migraine, amaurosis partialis fugax, and bronchial asthma. All those conditions have as a common denominator vasomotor instability. Horniker was able, entoptoscopically, to observe the spasm of the perimacular arterioles, slowing of the circulation, and enlargement of the central avascular zone. He emphasized the fact that macular tissue is particularly susceptible to vessel disturbances. This susceptibility is expressed clinically by the round-shaped edema limited to the zone where the layer of fluid-absorbing nerve fibers is the thickest.

In this country Gifford[12] and Marquardt became the principal exponents of the theory of vasomotor instability as the etiologic factor of central serous retinopathy. Their painstaking studies helped to define the vasoneurotic personality who is prone to develop recurrent attacks of macular angiospastic retinopathy. Their methods in diagnosing functional vascular disturbances were: skin thermometer reading, oscillometry, and capillary microscopy of the nail bed. They also postulated that those patients usually manifested a positive cold-pressor test, a low basal-metabolism rate, and high blood-cholesterol level.

Hartman[20] went one step further by including in his paper, published in 1953, an exhaustive psychiatric evaluation of the patients in which he demonstrated the close relationship existing between the emotional shock and the onset of central serous retinopathy.

The exact site of the edema is no less obscure, since nobody as yet produced an authentic pathologic specimen. While Horniker and Gifford and Marquardt were inclined to incriminate the water-clogged nerve fiber layer, Guist felt that there was a transparent biconvex layer of fluid in front of the retina. Finally Walsh and Sloan[6] expressed the opinion that the condition is a flat well-circumscribed macular detachment hence their appropriate descriptive name: "idiopathic flat detachment of the retina." They based their opinion on direct observation of two cases with the Friedenwald instrument, noting the forward displacement of the retinal vessels at the margins of the affected area and reduplication of the light beam, thus assuming that the anterior surface represented the retina proper, whereas the posterior surface reflected the pigment layer. The transient hyperopia frequently observed in the initial stages could be explained by the forward displacement of the percipient elements.

Streiff,[7] in 1939, was the first, to my knowledge, to describe two cases with both eyes involved simultaneously. The first case resembles closely the generally accepted clinical picture of central serous retinopathy followed 20 days later by absorption of edema and functional restitutio ad integrum. The second case presented, in addition, a hypopyonlike fluid level with yellowish deposits at the bottom of the bleb. After a year of observation, the condition remained stationary in both eyes and the central visual acuity was permanently lost. Logically, the author concludes that we are dealing with two separate conditions both characterized by circumscribed macular edema and lack of signs of inflammation. They differ, however, in many other respects: whereas, the first case is angiospastic, the second is infectious; retinal edema has, as its counterpart, a choroidal hypopyon; retinal exudates (referring to the yellowish dots appearing in central serous retinopathy) are opposed to choroidal exudates, good prognosis in the first case contrasts with poor prognosis in the latter.

The possibility of an allergic factor was first raised by Loewenstein[8] (1941) who draws the parallel between central angiospastic retinopathy and an urticarial wheal. He believes that many cases of central angiospastic retinopathy can be explained as an allergic vessel reaction followed by edema. His view is supported by Bothman[9] (1941) who describes cases of transient macular

edema occurring during attacks of allergic manifestations in the body elsewhere.

A critical review of the pathology of serous macular exudation was presented by Duggan[10] in 1942. While it is beyond my scope to present a detailed description of this interesting paper, it suffices to mention some of the outstanding arguments. Duggan questions the validity of the retinal angiospastic theory, since spasms of smaller branches of the retinal arteries are rarely central and produce but a slight elevation of the edematous area.

Permanent pigment changes, so often seen as sequelae of a central serous retinopathy, are characteristic of choroidal and not retinal lesions. The symptomatology and the course of the disease can be easily interpreted if one assumes that the transudate is subretinal originating in the choriocapillaries. The difference, therefore, between simple subretinal edema and disciform degeneration is only a matter of degree.

Duggan also notes that micropsia, frequently cited as a characteristic symptom of central serous retinopathy, is only present when there is little or no gross reduction of visual acuity. With this statement I am in complete agreement.

In his final remarks Duggan concludes that "these vascular changes and the resulting tissue anoxia are the final common pathway whereby a number of apparently unrelated etiologic agents can produce the same pathologic lesion." There, again, I am in complete agreement with that author.

Stenstrom,[11] in 1943, also was able, with aid of a microscope and slitlamp, to observe the presence of subretinal fluid in his published cases. He also tried to prove the possibility of several etiologic factors producing the same picture of central serous retinopathy.

For the sake of completeness one should mention six cases of macular edema following cataract extraction, published by Nicholls[22] in 1952, of which one had a typical ophthalmoscopic picture of central angiospastic retinopathy.

If one follows Duggan's reasoning we can reconstruct the chain of events as follows: decompression of the eyeball as a result of surgery will deprive the small retinal arterioles, whose caliber is already narrowed by senile sclerosis of its normal vis a tergo, with resulting anoxia of the capillary walls. This in turn will cause increased capillary permeability and passage of plasma in the surrounding tissue.

Cordes,[13] at the request of the National Research Council, Subcommittee of Ophthalmology, published in 1944 an exhaustive report on 176 cases of "Foveomacular retinitis" observed in the Navy.

Some of the statistical data concerning residual vision, pathologic changes, etiologic factors, and so forth, compiled by several field observers, are worth repeating. One of the co-workers reports a formation of a minute hole in the central area with permanent visual impairment in about 50 percent of cases recovered from central serous retinopathy. In some cases there was considerable piling up of pigment around the fovea almost simulating a hole.

Visual acuity during the height of the attack ranged from 5/200 to 20/20. At times, however, the improvement, as the condition receded, was followed by further loss of visual acuity. Reports on binocular involvement ranged from 25 to 61 percent but in most instances the second eye became involved after the first had healed. The average residual scotoma ranged between 0.5 to 3.0 degrees, thus covering the area where pigmentary disturbance occurred. Area of service, occupation, and results of physical examination were inconclusive in helping to find the etiologic factor or factors involved.

Cordes, in reviewing the pathologic aspect of this entity, rightly concludes that the residual loss of visual acuity will largely depend on the duration of compression of the conducting nerve fibers, the ultimate results being secondary degeneration and hole formation.

The case of "serous central choroiditis" described in 1946 by Bonnet, Paufique, and

Bonamour[16] deserves to be mentioned since one finds here again a description quite similar to the one given by Streiff in 1939, namely, a macular wheal with a horizontal fluid level containing hypopyonlike sedimentation. Briefly, this constitutes a focal exudative choroiditis without vascular and inflammatory changes. The condition became bilateral and the prognosis, in regard to visual acuity, poor. This, then, is another example of a macular exudate where the connection with central serous retinopathy is remote but is, nevertheless, classified in the medical literature with the angiospastic retinopathies.

Ida Czukrasz[19] (1951) presented a case of "chorioretinitis centralis serosa" where the residual scotoma disappeared after 11 months. She demonstrated the persistence of metamorphopsia by testing the macular function with "Amsler's square" which in proven cases shows a rhomboid deformity.

Keeney's[20] contribution (1951) consisted of a detailed discussion of differential diagnosis of "central serous retinosis" thus narrowing the possibility of confusing this entity with other macular afflictions.

Allergy as an underlying primum movens in initiating retinal angiospastic phenomena was again emphasized by Conrad Berens, et al.,[21] in their symposium on ocular allergy before the Academy of Ophthalmology and Otolaryngology in 1952. Another case with an unfavorable outcome was presented by Henry[24] before the Chicago Ophthalmological Society in 1951. Visual acuity in the affected eye improved to 20/40 but later dropped to 20/100 when a macular cyst was noted.

Riehm's[25] case published in 1952 is identical in its ophthalmoscopic appearance to the previously described cases by Streiff and Bonnet, et al.—bilateral macular bleb with fluid level containing yellowish exudate, protracted course of one and one-half years, followed, however, by complete recovery. As proof that central serous retinopathy can follow inflammatory foci elsewhere in the body, Kozlowski[31] (1954) cites a typical case which arose in connection with a cyst of the maxillary sinus.

An attempt to classify this heterogeneous group of macular lesions of functional vascular origin has been made by Bertha A. Klien[28] in 1953. She divides these conditions into three groups: (1) The process is limited to the retina, (2) the choroid participates in the formation of transudate, and (3) the choroid is, at least at the onset, the first part affected.

The author supports her view with a pathologic specimen (an eye enucleated for possible malignant melanoma) belonging to the choroidal-retinal group, showing edema of Henle's fiber layer and detachment of the internal limiting membrane as a result of transudation from the perimacular retinal vessels, whereas the detachment of the pigment epithelium and of the retina is due to choroid vessel transudation.

She rightly concludes that "participation of the choroid deprives the attacks of their fleeting character." Normal retinal and choroidal blood vessels, absence of any destruction of the choroid, and presence of residual silvery figures in the circumscribed area of the old transudate are the signs which can permit the observer to distinguish this condition from an inflammatory or degenerative macular disease. Klien is also of the opinion that the etiologic factors involved in those patients are infectious, toxic, allergic, endocrine, and metabolic as well.

Discussion

This review of the accumulated literature on this subject, while being far from complete, permits one to make a few broad statements.

The entity which, for lack of a better name, is called central serous retinopathy, is characterized subjectively by micropsia, metamorphopsia, and a positive scotoma. The first two signs can be absent, if there is a substantial and rapid decrease of visual acuity. Vision during the height of the attack can range from 5/200 to 20/20, and there is a central scotoma for form and

color, usually relative but occasionally absolute.

The ophthalmoscopic picture consists of an edema of the macular area, its edge showing a circular or oval light reflex. About two weeks after the onset one frequently finds small white or yellowish-white dots in the area of the swelling. The disease is apt to occur between the second and fourth decade, males being more often afflicted than females, and it has a tendency to recur in the same eye. Bilaterality has been observed, although simultaneous involvement is rare.

The prognosis depends, to a great extent, on the duration of the swelling and, I would like to add, on the depth of the edema. Consequently, the residual damage can range from a minute relative scotoma to a total loss of foveal vision, or from a minute pigment dispersion to a macular cyst.

Central serous retinopathy is, in all probability, only one of the numerous forms of functional vascular conditions leading to macular edema. The depth of the edema can range from simple swelling of nerve fiber layers (and possibly forward displacement of the internal limiting membrane) to an actual detachment of the retina and pigment epithelium as well. In the latter case a combined chorioretinal participation must be assumed.

The literature suggests a great variety of etiologic factors: infectious, toxic, allergic, endocrine, and metabolic in conjunction with vasomotor instability. The relative infrequency of angiospastic retinopathy can be misleading; it is quite possible that only macular involvement comes to our attention, whereas peripheral attacks can pass completely unnoticed.

Case reports

Case 1

G. R., a white man, aged 47 years, a precision-instrument maker, noticed a "fog" in front of his right eye, which he attributed to faulty bifocals. A routine physical examination conducted in the meantime in his factory showed poor visual acuity in the right eye. The refractionist, whom he consulted, referred the patient for further studies.

The patient was seen for the first time on October 29, 1954. At that time his uncorrected vision was 3/200 in the right eye and 20/25 in the left eye. Visual acuity in the right eye could not be improved with lenses of pinhole; whereas vision in the left eye with +10D. sph. was 20/20. The patient stated that the first symptoms appeared about two weeks previously. When questioned, he was unable to remember having experienced micropsia or metamorphopsia.

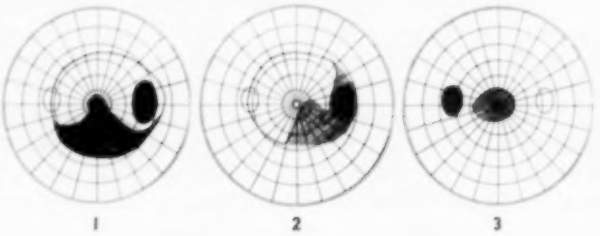
Both anterior ocular segments were normal, with the exception of a single subcapsular bleb in the right lens. Intraocular pressure was 18 mm. Hg (Schiøtz) in both eyes.

In the right fundus there was a well-circumscribed macular elevation of three to four diopters. The area was dotted with white-yellowish punctates and nasally to the fovea one could distinguish some pigment disturbance giving a moth-eaten appearance to this area. The vascular pattern was normal and the rest of the fundus details were not remarkable. The left fundus was essentially normal.

General medical history was negative except for the fact that the patient was considered a "high-strung" individual, subject to mental depression and was an avid cigar smoker. Mention should be made of the fact that a few months previously the patient had a shocking experience: his father who was suffering from advanced cerebral arteriosclerosis was killed by falling out of a second story window. According to his family, our patient blamed himself for the accident and had been mentally depressed ever since.

Field studies showed a seven to eight-degree absolute central scotoma and a relative centrocecal scotoma. The left field was normal.

During his hospitalization from November 1 to 7, 1954, the patient received daily intravenous infusions of 20 units of ACTH in glucose, nicotinic acid orally, and sedation. Routine laboratory studies were all nega-



Figs. 1, 2, and 3 (Wolkowicz). *Case 1.* (1) Central field of the right eye, in the receding stage, showing a typical dense central scotoma. (November 24, 1954; white, 5/1,000 and 2/1,000.) (2) Central field of the left eye, at the onset of the disease, showing a bundle-type defect skirting the central fixation. (November 29, 1954; white, 5/1,000 and 1/1,000.) (3) Central field of the left eye nine days later, showing loss of central fixation. The bundle-shaped defect is still recognizable. (December 8, 1954; white, 5/1,000 and 1/1,000.)

tive. On November 17th one could notice the edema in the right eye subsiding and vision improved to 20/80 − 1. On November 24th, further improvement was noticed and visual acuity rose to 20/60 − 2 (fig. 1).

On November 29th, the patient became very perturbed because the vision in his left eye was then blurred and objects appeared distorted. The left fundus revealed an area of edema below the fovea, its upper margin being sharply outlined, the lower limit indistinct and gradually blending with the disc margin nasally and the surrounding retina below. There, again, the vascular pattern was unaffected. Central field tracings (fig. 2) showed a sector-shaped defect of the two-mm. isopter with baring of the blindspot, roughly corresponding to the affected area. The visual acuity was then 20/40 in the left eye.

A week later the edema began to spread upward (thus a gravitational factor can be discounted) and the field defect showed correspondingly a "break-through" involving the macula and still retaining the appearance of a bundle defect (fig. 3). The visual acuity meanwhile dropped to 20/200 in the left eye. During the subsequent visits the field changes gradually assumed the form of a round absolute central scotoma of three degrees, whereas the fundus picture presented the typical appearance of a round reddish wheal covered with numerous yellowish dots.

The patient was again hospitalized from January 12 to 28, 1955. A new round of studies, including allergy tests, showed nothing significant and the patient was given a course of fever therapy with typhoid vaccine and ACTH on alternating days. The progress of the disease seemed completely unaffected by the treatment. About two months later one could notice a complete flattening of the macula area in both eyes. The difference was only in the pigment distribution, the right macula showed a moth-eaten appearance, the left macula presented some scattered and hardly noticeable pigment. Eventually the visual acuity remained 20/200 in the right eye and 20/100 − 1 in the left eye with an absolute central scotoma of five degrees in the right and one degree in the left eye.

Case 2

E. C., a white man, aged 34 years, a bookkeeper, came to the eye clinic in the Wills Hospital on July 2, 1953, stating that about a month ago during the course of a routine eye examination, prior to a minor operation, he was told that the vision in his right eye was impaired. In retrospect, he was able to state that for the past two years he was aware of some recurrent visual disturbance. He was certain that his visual acuity was always normal at least as far back as 1946 when he had an Army examination.

Past medical history revealed that the patient had jaundice while in military service but otherwise had been in comparatively good

physical health. Visual acuity was: R.E., 2/60 not improved; L.E., 6/5.

Funduscopic examination revealed in the right eye: clear media, normal nervehead, macular area "granular in appearance," foveal reflex absent, retinal peripheries normal. The left eyeground was essentially normal and the "foveal reflex intact."

A provisional diagnosis of "retrobulbar neuritis" right eye was made and the patient underwent routine laboratory tests and skull X-ray studies which were all negative. Central field studies revealed an absolute scotoma of about three degrees and a relative centrocecal scotoma in the right eye. The left visual field was normal.

Neurologic consultation showed no evidence of symptoms referrable to the central nervous system.

In March, 1953, the patient was re-examined. Funduscopic examination done on March 12th showed the characteristic picture of central serous retinopathy—macular edema peppered with small yellowish dots—nervehead and blood vessels being normal (fig. 4). Although the patient did not complain about his left eye, the examiner (P. R. McD.) noted a small patch of edema between the nervehead and the fovea. The patient was placed on cortisone treatment orally without any apparent results.

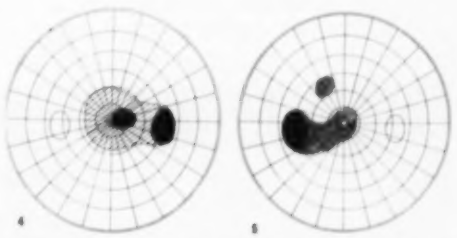
In October, 1954, the patient suffered a severe emotional upset when his father committed suicide.

In November, 1954, he began to complain of blurred vision in the left eye. A field test showed a bundle defect extending from the disc inferiorly and anchored at the fixation point and another scotoma above the papillomacular area. This time the left eyeground revealed a typical picture of central serous retinopathy and the visual acuity was reduced to 6/15. The patient was also aware of micropsia and metamorphopsia in the left eye.

He was hospitalized from November 29 to December 11, 1954, and was subjected to extensive laboratory studies including basal-metabolism rate and spinal-fluid examinations. A slight increase of total protein (68 mg. percent) in the spinal fluid was the only positive finding. All other tests were within normal limits. During his stay in the hospital the patient was given fever therapy with typhoid vaccine intravenously and ACTH on alternating days. On his subsequent examinations each macula was flattened to a great extent. The visual acuity remained less than 6/60 in the right eye but improved to 6/9 − 3 in the left.

On March 12, 1955, the patient suffered a relapse in the left eye (fig. 5). The fundus revealed a circumscribed macular edema and visual acuity came down to 6/30 + 1.

The patient was admitted to Lankenau Hospital on March 25th and was discharged on April 2nd. This time the only positive finding having any possible connection with the patient's ocular condition was an allergic rhinitis diagnosed by the E. N. T. consultant. On his return to the office, vision in the left eye was 20/200. The following notation was made on the patient's chart: "O.D. shows very faint pigment disturbance in the macular region, a few depigmented spots scattered about, rather typical of central serous retinopathy. Left macula does not show very much edema."



Figs. 4 and 5 (Wolkowicz). *Case 2.* (4) Central field of the right eye at the height of the attack, showing a centrocecal type of scotoma. (March 12, 1954; white, 5/1,000 and 2/1,000.) (5) Two days after a relapse of central serous retinopathy in the left eye. Field studies showed a bundle-shaped defect. A small detached paracentral scotoma was found consistently on all subsequent tracings. (March 14, 1955; white, 10/1,000 and 2/1,000.)

Since no further improvement was noted, the patient was again hospitalized from April 23 to May 11, 1955. During his last stay in the hospital, he was given fever therapy with typhoid vaccine intravenously. On his discharge the visual acuity was: counting fingers at one foot in the right eye, and 20/50 −1 in the left eye. The fundus picture remained essentially the same. The condition remained stationary and no further progress was noted.

Comment

The two cases of bilateral central serous retinopathy which have been presented fulfill the diagnostic criteria of this entity. Subjective signs of micropsia and metamorphopsia were present in the less affected eye, thus confirming Duggan's statement that micropsia is only present when there is no gross reduction in visual acuity. The objective signs consisted of (1) ophthalmoscopic findings and (2) field changes.

The first affected eye (the right eye in both cases) had been seen several weeks after the onset and the funduscopic picture corresponded, therefore, to the typical description of central serous retinopathy: macular circumscribed edema covered with yellowish dots (fig. 6). In the second eye the retinal changes were observed from the start.

A patch of retinal edema was noticed in Case 1 below the macula and in the papillomacular space in Case 2. In both instances the edema gradually shifted, in the first case upward and in the second case temporally, thus discontinuing the possibility of a gravitational fluid seepage. There, too, the edema ultimately took up a round parafoveal contour and shortly thereafter the yellowish characteristic dots could be observed. Finally, the edema subsided and a faint pigment disturbance remained as the only ophthalmoscopic evidence of the previously affected macula.

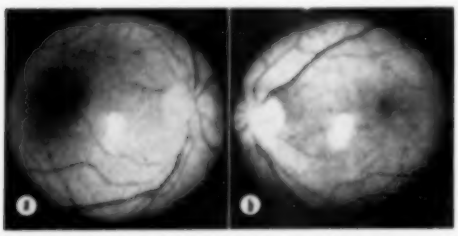


Fig. 6 (Wolkowicz). *Case 1.* (a) Right eye. (b) Left eye. Central serous retinopathy does not lend itself well to black-and-white photography; however, scattered yellowish dots in the central area can be seen distinctly in both central zones. Pigment disturbance in the right macula can also be clearly visualized.

The field changes followed closely the ophthalmoscopic findings. The first affected eye having been seen at the height of the attack showed an absolute central scotoma. The right eye in Case 2 which was the most severely affected showed, in addition, a relative centrocecal scotoma. In the eyes where the edema could be observed and followed soon after its appearance, the field changes presented a bundle defect, gradually creeping toward the macula and finally covering the fixation point.

This, in my opinion, gives a strong support to the theory that the nerve-fiber layer is the most affected part of the retina and the reason for the ultimate central location of the edema is purely anatomic—the thickness of the fiber layer of Henle lends itself to the absorption of large quantities of fluid. Ultimately excess transudate may displace forward the hyaloid membrane and find its way to the deep layers of the retina separating the cones and thus creating micropsia. In more severe cases fluid may eventually accumulate beneath the retina forming a flat macular detachment.

The differential diagnosis, when our patients' condition reached the peak of attack, became rather simple. Lack of inflammatory signs in the blood vessels and vitreous ruled out a central choroiditis. Central serous retinopathy may, on occasions, be mistaken for an acute axial retrobulbar neuritis. In fact, Case 2 had been treated as such for over six months before the macular changes became unmistakably clear.

Idiopathic macular degeneration and heredofamilial degeneration of the macula could be confused with central serous retinopathy, if the patient is seen in the cicatricial stage and the ophthalmologist is trying to establish a diagnosis in retrospect. A careful history, recollection of recurrent episodes, and, if possible, examination of other members of the family should give enough clues to differentiate each entity.

Actinic retinitis may be, in its active phase, strikingly similar to central serous retinopathy, but, here again, history of solar exposure and lack of relapses will be the deciding factors in shaping the diagnosis.

Juvenile disciform degeneration of the macula can usually be recognized by the size and peculiar shade of the mound and the frequent coexistence of subretinal hemorrhages and retinal exudates.

The condition which is most frequently confused in the literature with central serous retinopathy and which is, no doubt, related to it etiologically, as well as pathologically, is central serous choroidopathy. The angiospastic process limited, for reasons unknown, to the posterior polar region produces a circumscribed retinal detachment. A fluid level can occasionally be seen, the protruding bleb containing flaky deposits. The end-result of this type of edema will be a yellowish, well-circumscribed area containing some ill-defined silvery figures. These is no pigment clumping as usually found in cicatricial choroiditis and no evidence of choroidal destruction.

Figure 7 shows the posterior pole of the right and left eye of Mrs. A. L., aged 58 years, who suffered loss of vision several years ago. She was examined for the first time on June 8, 1955, when the visual acuity was found to be 20/200 in each eye not improved with glasses or pinhole. The fundus picture, it was felt, was characteristic enough to warrant in retrospect a diagnosis of a healed central serous choroidopathy.

The element of emotional shock often found in recent publications is ominously

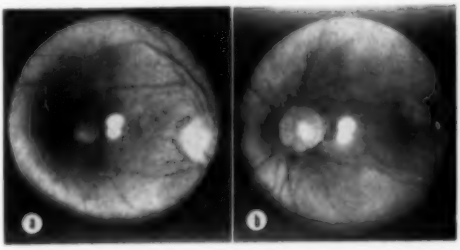


Fig. 7 (Wolkowicz). (a) Right eye. (b) Left eye. The macular scar is sharply circumscribed in both eyes. Lack of pigment clumping, usually found in cicatricial choroiditis, is conspicuously absent. A few silvery flakes can be recognized within the area of the scar.

present in these cases. Contrary to the generally accepted opinion that the course of the disease is toward recovery, these patients lost their central vision in both eyes. While an occasional case with a poor prognosis has been mentioned by several authors, the patients reported here are the only two fully recorded cases of bilateral central serous retinopathy followed by bilateral loss of central fixation.

Experimental Data

The approach to animal experimentation was based on the theory that, though the etiologic factors are numerous, they all seem to have a common pathway resembling an urticarial wheal. The subsequent course of events, namely, duration, extent of residual loss of field and/or vision, and retinal scarring, will depend on the extent and intensity of the vascular insult. However, the edema with all its damaging effects will persist and run its course long after the vascular disturbance becomes quiescent.

Since, for all intents and purposes, the chain of events, as already described, closely resembles a nonspecific focal allergic reaction, we felt that we could further our knowledge of the underlying pathologic process in this condition by provoking a localized retinal allergic reaction by at least two different approaches. A similar vascular response in both methods would have fit this reasoning very nicely.

The first procedure followed closely the technique described by Vogel[23] in producing experimental fundal lesions. It consisted in injecting into the suprachoroidal space of a rabbit's eye about 0.01 cc. of horse serum while observing directly the course of the needle with an ophthalmoscope. The rabbit was firmly immobilized during the procedure in a specially designed box padded with rubber foam.

The eye was anesthetized with 0.5-percent pontocaine and a retrobulbar injection of Novocain. The assistant proptosed the eye with a muscle hook and kept the animal's head in a steady position. The ideal place to balloon out the retina and choroid is right below the disc where the site can be easily located with an ophthalmoscope on subsequent examinations, as well as on pathologic sections, the optic papilla serving as a landmark.

The next day the bleb was flattened and two to three days later the fundus appeared ophthalmoscopically normal. If the retina was pierced inadvertently during the procedure and some fluid escaped into the vitreous, one could observe for some time a few stringy opacities; the retinal break, however, would heal promptly beyond any recognition.

Two weeks after the initial injection 1.0 cc. of horse serum was injected intravenously. On occasions the dose was repeated a week later, if no reaction was observed. As a rule the results were erratic. In some instances the intravenous horse serum was shocking enough to kill the animal.

Some rabbits showed no reaction whatsoever. In those rabbits who responded favorably the reaction consisted of a faint aqueous flare, vitreous haze, temporary vessel engorgement, and retinal focal edema which was difficult to outline because of the overlying vitreous reaction. If left alone, the reaction would clear up in about eight to 10 days. Rabbits' eyes, where the reaction was judged adequate enough, were enucleated, fixed in formalin. They were then processed in the usual way for microscopic studies.

The second procedure was based on observations made by Hei-u Ko in 1933-1934. That author, after drawing a parallel between central serous retinopathy (called in the Japanese literature "Masuda's chorioretinitis centralis" and "retinitis centralis photodynamica") produced in animals, describes the retinal lesions obtained in rabbits, previously sensitized with eosin or tripaflavin, by irradiating the eyes with direct sunlight or carbon-arc light filtered through a Crookes B2 lens.

Another method, giving similar results, consisted in ligating the ductus choledochus and subjecting the eye to carbon-arc light three days later. Unfortunately the details of the photosensitization technique are described in a previously published article edited by the Medical School of Seoul which could not be obtained.

It was decided, therefore, to use a solution of commercially available eosin and compare the results by changing the concentration, time elapsed between the injection and irradiation, and length of light exposure. After several trials and errors a well-outlined retinal edema was obtained by sensitizing the animal with two cc. of one-percent eosin solution intravenously. The eye was exposed to carbon-arc light seven days afterward, for approximately two minutes, by using the Zircon arc photomicrographic lamp, Fish-Schuman Corporation. The narrowest possible beam was used, the wavelength being 0.3 micron up to one micron, maximum energy being in the 0.7 to 0.9 region of white light.

In this particular case illustrated in Figure 8, the pupil was dilated prior to the experiment in order to facilitate a quick fundus view. We feel that the four successive areas of edema are caused by the dilated pupil, which permitted the rabbit to change the area of fixation and still be exposed to the light. The area of edema was directly in the center of the posterior pole, beneath the nervehead. Ophthalmoscopically the resemblance to cen-

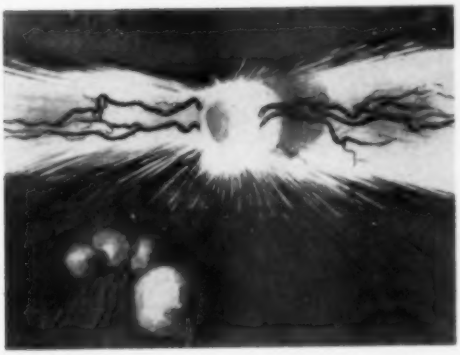


Fig. 8 (Wolkowicz). Artist's view of the photosensitized rabbit's eyeground immediately after exposure to light. The elevation of the successive wheals and the sharp delineation from the surrounding retina are somewhat exaggerated in this drawing.

tral serous retinopathy was rather striking. Each wheal was well outlined, purple-reddish, elevated seven to eight diopters, and surrounded by healthy looking retina. The blood vessels, to all appearances, were normal. A few moments later the animal was killed, the eye enucleated in the usual manner, and fixed in formalin.

Pathologic description

The eyes of the rabbits, who were subjected to shocking doses of horse serum, presented a variety of structural changes ranging from a normal section to massive edema. The results were far from uniform and followed closely the ophthalmoscopic picture. Albuminous, lightly staining fluid could be found in all the eyes where the anaphylactic reaction was present. One could distinguish fluid collection in the suprachoroidal space in some preparations. In others there was fluid separating the retina and, on occasions, a preretinal layer was found. The choroid and the retina presented accordingly the same lack of uniformity. Figure 9 shows edema separating the connective tissue lamellae of the choroidal stroma. Fluid collections can be easily distinguished in other parts of this preparation.

Figure 10 shows a serous pool lifting a normal looking choroid from the sclera. The

Fig. 9 (Wolkowicz). Marked choroidal edema separating the stromal lamellae. Albuminous fluid can be seen between the choroid and the retina (the latter not shown in this photograph).

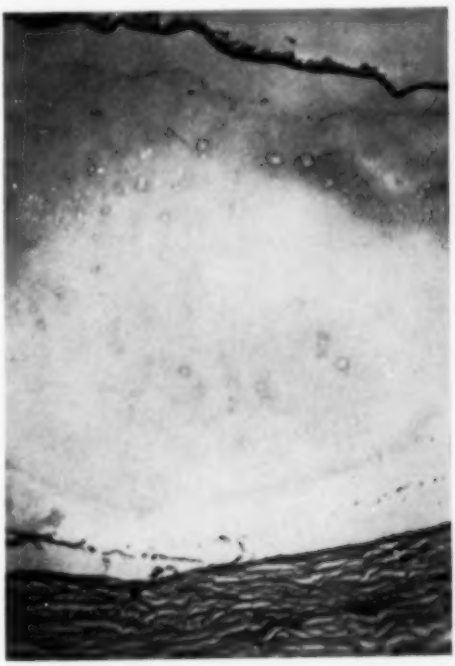


Fig. 10 (Wolkowicz). Normal choroid separated from the sclera by a large pink-staining fluid collection.

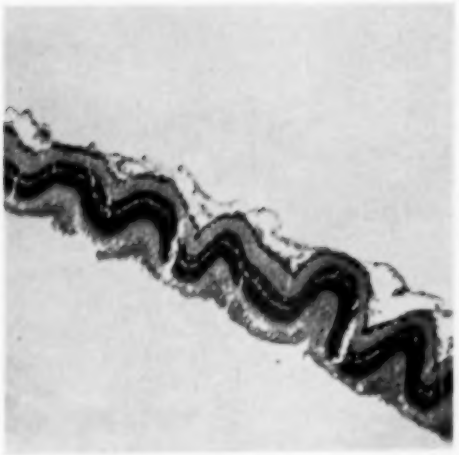


Fig. 11 (Wolkowicz). Edema is evident in the rod-and-cone layer, as well as in the nerve-fiber layer.

portion of the retina presented in Figure 11 is detached from a normal appearing choroid (the latter is not shown in the photograph). While the detachment may well be an artefact the edema of the nerve-fiber layer and the layer of cones and rods is quite conspicuous.

Focal exudation produced by photosensitization formed an elective, well-limited area of vascular reaction, clinically, as well as pathologically, more closely resembling a serous retinopathy seen in humans. Figure 12 shows a cross section of the retinal wheal where one can clearly identify a layer of fluid separating the retina from an otherwise normal choroid and another collection which appears preretinal but in reality splits the innermost nerve fibers. Edematous spaces in the cone and rod layer are also clearly visible. The choroidal separation is in all probability an artefact.

Discussion

These rather crude laboratory experiments confirm the well-known dictum that exudation is the essence of any vascular allergic response and this holds true of the eye as well. The vascular insult can be selective, involving only the retina or only the choroid. One could foresee that the technique of sensitizing the animal with horse serum through

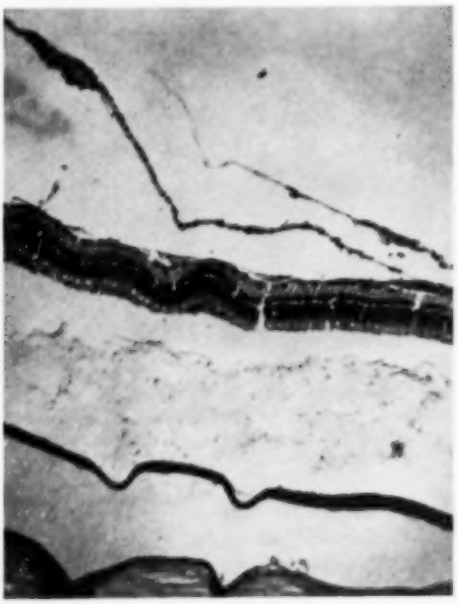


Fig. 12 (Wolkowicz). A large collection of fluid separates the retina from the choroid below and another one splits the nerve-fiber layer above.

a suprachoroidal injection will produce mainly a choroidal vascular response or at best a generalized reaction where choroidal and retinal vessels will equally participate in the outpouring of plasma. This turned out to be true if one may judge by the slides examined, and by the rabbits' funduscopic picture.

Ko's method of photosensitization proved to be more selective, since the assumption is that the retinal vessels were predominantly exposed. From the pathologic studies one can safely assume that the exudate, which separated the nerve-fiber layers and swelled the cone and rod layer, ultimately accumulated beneath the retina producing a retinal detachment. Exudation of choroidal origin would have lifted, first of all, the pigment epithelium, and the retina only secondarily.

Conclusion

In the section entitled "Historical review" I endeavored to present the views of the authors, who, in some degree, contributed to

shaping our opinion concerning the etiology and pathogenesis of central serous retinopathy. The contradictory theories concerning the etiologic factors involved, the pathology, the clinical course, and the prognosis were also noted.

The following observations could be made from two cases of bilateral central serous retinopathy:

1. The emotional shock factor, frequently mentioned in later publications, was present in these patients.

2. In a proven case of central serous retinopathy where the initial vascular insult is, by definition, limited to the retinal arterioles, the area of edema involves, foremost, the nerve-fiber layer. The location may well be paramacular, the shift toward the macula being caused by the exceptional thickness of the fluid, absorbing nerve fibers in this area. If one follows this reasoning a step further, one may assume that it is quite conceivable that many cases of serous retinopathy might pass unnoticed because of their peripheral location.

3. The course of the disease, while usually benign, will depend on the amount of transudate and on the ability of the vascular bed to reabsorb the fluid. Large amounts of plasma and slow absorption will cause swelling and separation of the nerve fibers, formation of large globular cystic spaces in the outer plexiform layer, ultimate swelling and distintegration of the rods and cones, and hole formation. It follows that the visual disturbances can be slight, manifested by micropsia, metamorphopsia, transient hyperopia, and small relative scotoma, or severe with loss of vision as low as 3/200 accompanied by absolute central scotoma. Between the two extremes one may observe all the intermediate stages of the disease.

4. The prognosis is, consequently, favorable in the majority of cases but, on occasion, loss of central vision may remain permanent. Judging from the literature, cases of bilateral loss of macular function are rather the exception.

The purpose of the animal experiments was to confirm the opinion expressed by Loewenstein, Duggan, and others that the vascular spasm is an allergic vessel reaction of which exudation is the most striking phenomenon. The etiologic factors are numerous, often unrelated but all follow a common pathologic pathway. The emotional shock may play the same role as the well-known fact of a nervous upset initiating an attack of bronchial asthma.

The vascular spasm was experimentally produced by two different methods: horse serum sensitivity and photosensitivity. The ensuing results differ in degree and origin of exudation. The first technique produced a scattered, predominantly choroidal vascular response which could be clinically linked rather to a serous choroidopathy. The edema involved the choroid itself and the excess amount of fluid would detach the choroid and/or the retina as well. On occasions the retina participated actively in the process of edema.

The second method produced a localized retinal vascular response. Here the course of the edema took an outward direction. The nerve-fiber layer was the first to take up the fluid. Some of it was absorbed by the cone and the rod layer and the excess accumulated beneath the retina separating it from the pigment epithelium.

The fact that in the latter experiment no fluid was present between the choroid and pigment epithelium is strongly suggestive that the choriocapillaris did not participate in the allergic reaction.

Summary

1. The literature concerning central serous retinopathy has been reviewed.

2. The differences of opinion as to etiology and pathogenesis of this disease have been restated.

3. Two cases of bilateral central serous retinopathy have been presented. Their early observations helped toward better understanding of the pathogenesis and clinical course of this disease. Their exceptionally

poor outcome reëmphasized the prognostic uncertainty of central serous retinopathy. Treatment has not been included in this study.

4. Animal experimentation was based on the assumption that central serous retinopathy is a localized allergic reaction of retinal arterioles, where many unrelated factors can be involved. It was not intended to reproduce the mechanism of central serous retinopathy in humans.

5. The results of the experiments seem to confirm the generally held opinions concerning the site and spread of retinal edema as a result of retinal angiospasm.

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UVEITIS*

I. Gonioscopy

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Gonioscopy has received wide acceptance in the study and management of glaucomatous processes. In uveitis this method of examination has been used mainly when hypertension was also present in an effort to find a mechanical basis for the glaucoma. Recently there has been increasing interest in gonioscopic examination of cases of uveitis without glaucoma,[1,2] and Moskowitz[3] advises that the angle be examined when recurrent uveitis is present in order to rule out the presence of foreign bodies in the angle.

It is the purpose of this paper to demonstrate the value of gonioscopy in uveitis. In this condition the angle abnormalities are not static, and it is helpful to make diagrams of the findings at different stages of the disease. This enables the examiner to follow the course of the condition and understand the pathogenesis of cicatricial end products, for example, synechias. Examination of enucleated eyes shows only one stage, usually the end-result of uveitis.

Troncoso[4a] describes several methods of charting gonioscopy findings. The method using three concentric circles has proved of great value. The innermost circle represents the root of the iris, the middle circle the scleral spur, and the outermost circle the line of Schwalbe. We have modified this method by adding 30-degree interval marks and profile views of the angle (fig. 1-a).

The 30-degree interval marks permit accurate localization of angle changes, if one considers the angle to be divided into 12 segments, as the face of a clock. The profile views, in the corners of the diagram, allow charting of angle changes in profile, in each quadrant.

Case reports

The 12 patients included in this article were examined by means of the slitlamp, gonioscope with Koeppe lens, direct and indirect ophthalmoscope. Although diagnostic studies for the more commonly accepted causes of uveitis were performed, etiologic

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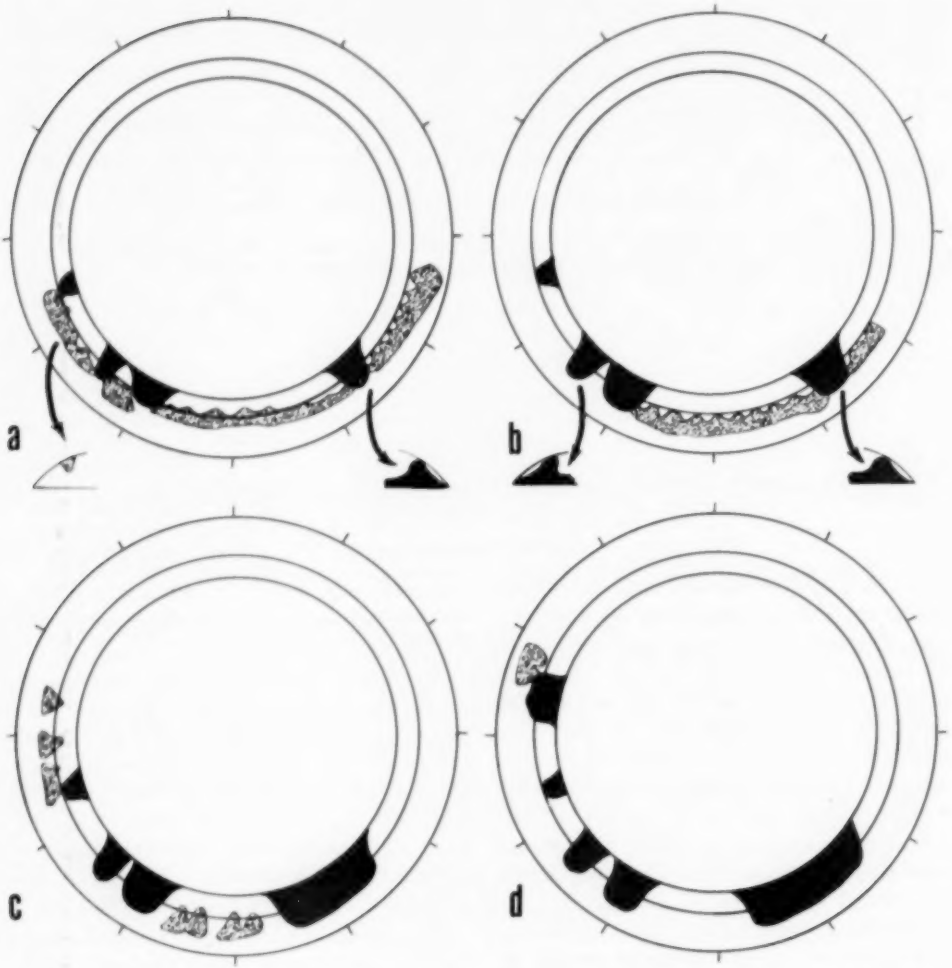

Fig. 1 (Brockhurst, Schepens, and Okamura). Case 1, right eye. Angle changes on successive examinations: (a) January 31. (b) March 15. (c) May 10. (d) June 21. As the exudates decreased in the angle, peripheral anterior synechias increased.

considerations have been omitted in order to simplify this report. It is noteworthy that in 11 of the 12 cases, inflammatory changes were also observed in the fundus, but in only one of these 11 cases were such changes at, or posterior to, the equator of the fundus and visible by direct ophthalmoscopy (Case 7). In the other 10 cases, the inflammatory changes of the posterior segment were in the extreme periphery and scleral depression was necessary in order to bring the affected area into view. The importance of the fundus periphery in uveitis will be considered more fully in a subsequent publication.

Case 1

A 31-year-old Chinese woman had noted gradual decrease of vision in the left eye for four months, and in the right eye for one week. Both eyes were white. Slitlamp examination showed a few small white keratic precipitates centrally in both eyes

and in the left eye two large mutton-fat keratic precipitates were seen at the 5-o'clock position near the limbus. The anterior chambers showed a one-plus flare and about 15 cells in the small round beam of the slitlamp. There were no iris nodules. Both vitreous bodies showed extensive membranes with fine white and pigmented particles scattered throughout. Both fundi showed gelatinous exudation on the pars plana ciliaris and ora serrata, but there were no inflammatory signs posterior to the ora serrata.

Gonioscopy of the right eye revealed several trabecular anterior synechias (fig. 1-a). From the 3-o'clock to 8:30-o'clock position, there was a ridge of gelatinous, mutton-fat type exudate which was deposited on the trabecula in the region of Schlemm's canal. This ridge had the appearance of a mountain range in profile with peaks jutting down toward the iris surface. Six weeks later no keratic precipitates were visible by slitlamp examination in the right eye.

Gonioscopy showed that the anterior synechia at the 4:30-o'clock position had become broader and the exudates had disappeared between the 7 and 8:30-o'clock position (fig. 1-b). Thirteen weeks after the first examination, the right eye showed fewer exudates in the angle, the synechia at 4:30 having increased so that it now extended to the 5:30-o'clock position (fig. 1-c). New exudates had appeared between the 8:30 and 9:30-o'clock positions. Eighteen weeks after the first examination, the right eye showed a new trabecular synechia at the 9:30-o'clock position and only two exudates at the upper edge of this synechia (fig. 1-d).

Gonioscopy of the left eye, at the first examination, showed peripheral anterior synechias at the 4:30 and 7-o'clock positions (fig. 2-a). At the 6-o'clock position, a large exudate extended about half-way to the iris plane, and adhering to this exudate was a tent of iris tissue (fig. 2-a [profile] and fig. 6). A ridge of exudate on the trabecula extended from the 2 to 6-o'clock position, with isolated globular exudates from the 6 to 9:15-o'clock position.

Six weeks later the left eye showed no keratic precipitates by slitlamp examination. However, gonioscopy revealed new exudates between the 12 and 2-o'clock positions (fig. 2-b). The most interesting finding, however, was the presence of a large mound trabecular synechia extending from the 5 to 6-o'clock position. This included the area formerly occupied by the exudate-iris adhesion at the 6-o'clock position. A new synechia was present at the 8-o'clock position.

Thirteen weeks after the first examination, there were fewer exudates but a new conical ciliary synechia was present at the 3:15-o'clock position (fig. 2-c). Eighteen weeks after the first examination, the left eye showed a further decrease in the number of exudates on the trabecula but there was no change in the synechias (fig. 2-d).

At no time was any elevation of the intraocular pressure measured in either eye.

Case 2

A 29-year-old white man was examined because of slight redness of the left eye with decrease in vision of three months' duration. The lower third of the left cornea showed about 20 large mutton-fat keratic precipitates. In the aqueous only a rare cell was visible and the iris was normal in appearance. Intraocular pressure was 17 mm. Hg (Schiøtz). Fundus examination revealed a gelatinous exudate, on the pars plana ciliaris, inferiorly; no posterior fundus lesions were observed. The left angle was of normal depth. Mutton-fat type exudates were found on the trabecula in all quadrants (fig. 3-a).

Six months later the keratic precipitates had disappeared, but ciliary conical synechias had formed at the 3, 5:30, and 6-o'clock positions (fig. 3-b).

The right eye appeared entirely normal including gonioscopic examination.

Case 3

A 54-year-old white woman was admitted to the neuromedical service for headaches of acute onset. After extensive investigation, a diagnosis of asepitc meningitis was made.

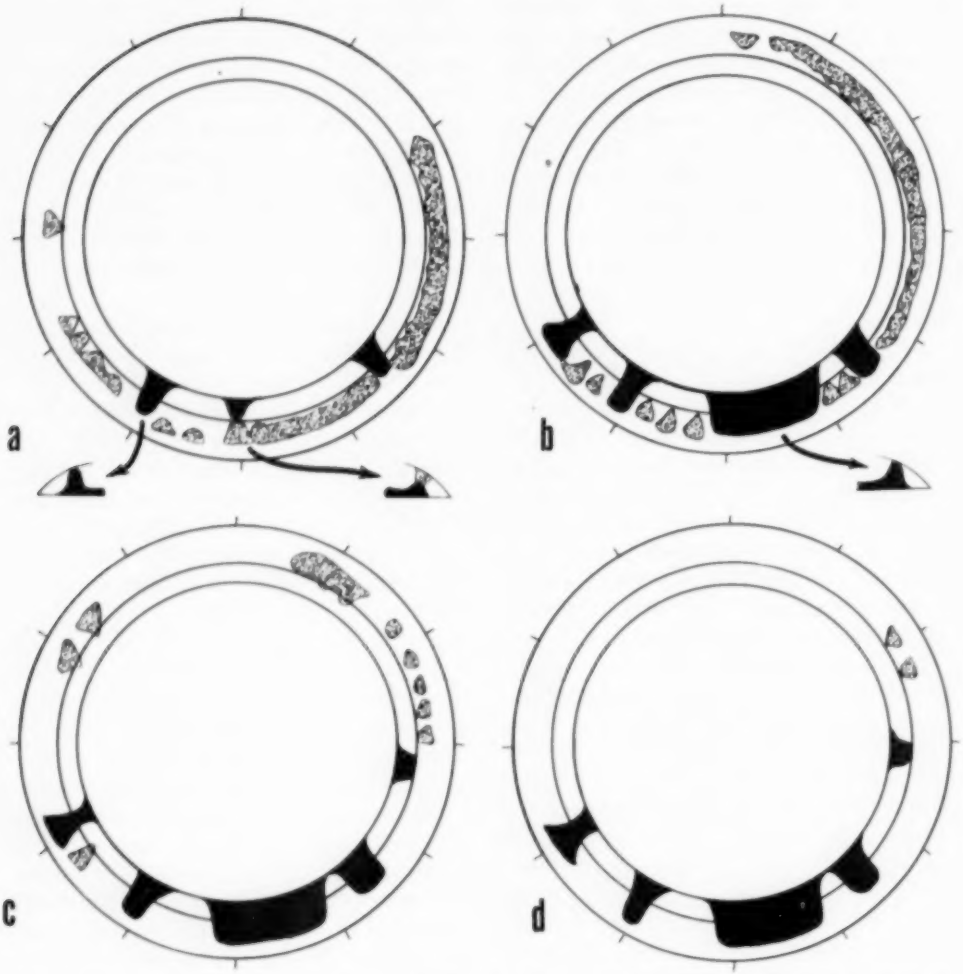

Fig. 2 (Brockhurst, Schepens, and Okamura). Case 1, left eye. Angle changes on the same dates as in Figure 1. The presence of exudates is followed by an increase of peripheral anterior synechias.

While under observation the right eye became inflamed. There were no keratic precipitates but a few cells were seen in the aqueous. The fundus appeared normal including the extreme periphery. Intraocular pressure was 37 mm. Hg (Schiøtz). Gonioscopy revealed the presence of mutton-fat type exudates on the trabecula, and tenting forward of the iris periphery at the 3 and 8:15-o'clock positions (fig. 4). The iris was adherent to the exudates at these two points. One month later all exudates were gone, but a ciliary synechia was present at the 8:15-o'clock position. Two months after the first examination, new exudates appeared in all four quadrants on the trabecula.

The left eye was never inflamed nor hypertensive, and the fundus appeared normal, including the extreme periphery; however it did show trabecular exudates.

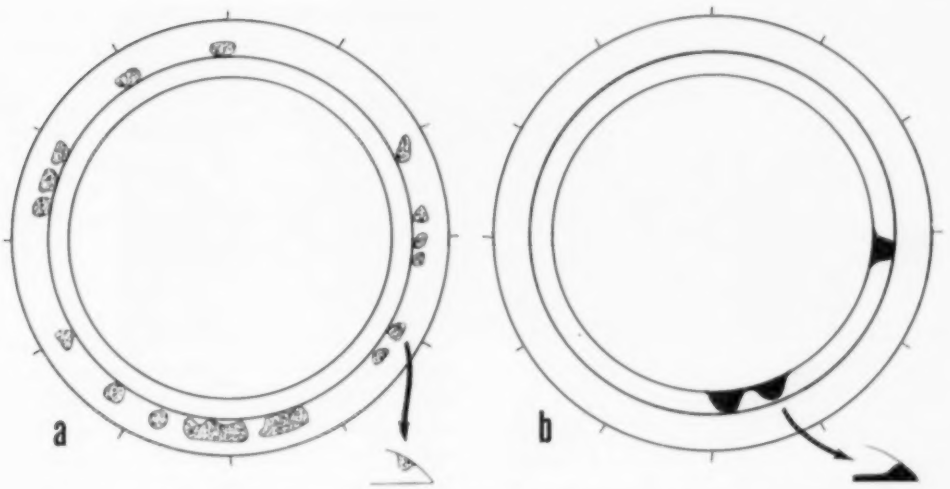

Fig. 3 (Brockhurst, Schepens, and Okamura). Case 2, angle changes on successive examinations: (a) March 7. (b) September 6.

CASE 4

An 11-year-old Negro girl came to the hospital for refraction. She was referred for fundus examination because of high myopia. The right eye was white and quiet but the fundus showed a flat peripheral detachment of the retina without breaks. Gonioscopy revealed the presence of a ciliary conical synechia at the 9-o'clock position, and a mound synechia extending from the 10 to 11-o'clock position.

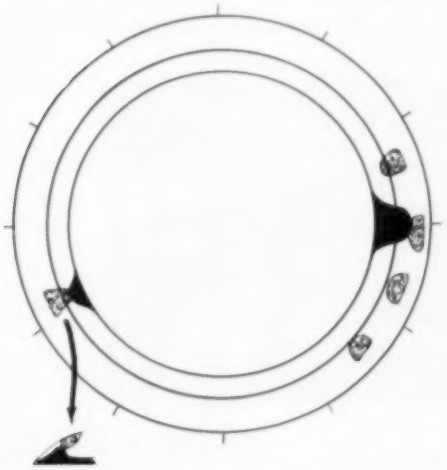

Fig. 4 (Brockhurst, Schepens, and Okamura). Case 3, right eye. Showing iris-exudate adhesions.

The left eye was white but showed a few fine keratic precipitates and a few cells in the aqueous. A flat retinal detachment was present in the extreme fundus periphery with numerous yellow intraretinal exudates temporally. Gonioscopy in the left eye showed numerous mutton-fat type exudates in all quadrants, and an iris-exudate adhesion at the 4:45-o'clock position (fig. 5). One month later the anterior chamber was clear, the intraretinal exudates were gone, and gonioscopy revealed only a ciliary conical synechia at the 4:45-o'clock position.

CASE 5

A 52-year-old white woman had noted vitreous opacities and blurring of vision in the right eye for one year. Examination showed no keratic precipitates, cells, or flare. Periphlebitis and exudates were seen inferiorly in the fundus, near the ora serrata. Gonioscopy showed a mutton-fat type exu-

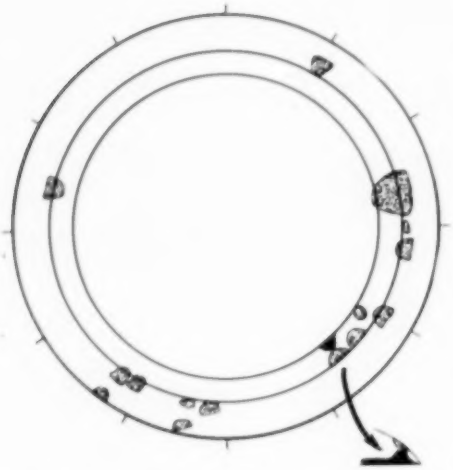

Fig. 5 (Brockhurst, Schepens, and Okamura). Case 4, left eye. Mutton-fat type exudates in the angle.

date on the trabecula at the 4:30-o'clock position.

CASE 6

A 58-year-old white woman complained of seeing spots for about one year in the left eye. There were no keratic precipitates but a slight flare and a few cells were present in the aqueous. The fundus showed a massive gelatinous exudate on the ora serrata and pars plana ciliaris between the 11 and 1-o'clock position and also from the 6 to 7-o'clock position. Gonioscopy showed conical trabecular synechias at the 6 and 7-o'clock positions. At the point of adhesion to the trabecula there were regressing exudates which were partially pigmented (fig. 7).

The right eye showed a small retinal break in an area of old chorioretinitis, at the equator.

CASE 7

A 70-year-old white woman had been treated for eight months for a low-grade secondary glaucoma in the right eye. The tension had been controlled for five months. The eye was white but showed about 50 mutton-fat keratic precipitates, slightly pigmented, and a few cells in the aqueous. In the fundus retinal veins were sheathed and an acute focus of chorioretinitis was present at the equator between the 7 and 9-o'clock positions. The ora serrata region could not be seen due to extreme vitreous haze in this region, possibly because of inflammatory lesions in the periphery. Gonioscopy showed exudates on the trabecula between the 6 and 6:30-o'clock positions, these exudates resembled the mutton-fat keratic precipitates found in the same eye (fig. 8).

The left eye appeared entirely normal.

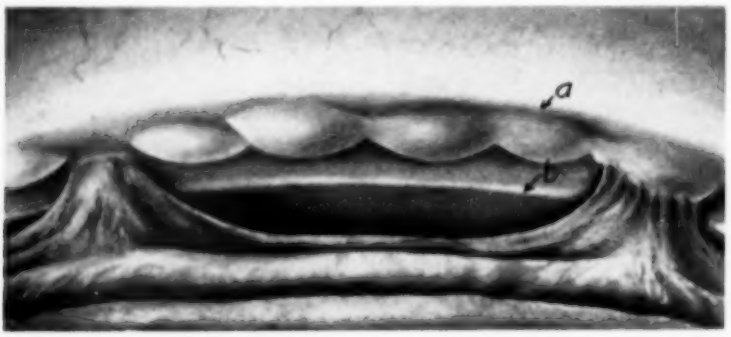

Fig. 6 (Brockhurst, Schepens, and Okamura). Case 1, left eye. Note exudates on filtration zone, trabecular synechia on the left, and iris-exudate adhesion on the right. Compare with Figure 2-a, from the 4:30 to 6-o'clock position. The iris-exudate adhesion, on the right in Figure 6, is located at the 6-o'clock position in Figure 2-a; and the synechia on the left in Figure 6 is located at the 4:30-o'clock position in Figure 2-a. (a) Schwalbe's line. (b) Scleral spur.

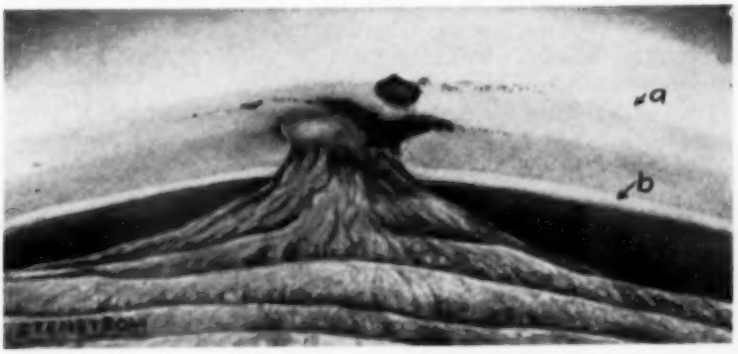

Fig. 7 (Brockhurst, Schepens, and Okamura). Case 6, left eye. Drawing of an angle taken from a photograph by Dr. David Donaldson. Note adherence of synechia to exudate. (a) Schwalbe's line. (b) Scleral spur.

CASE 8

A 43-year-old white woman complained of mild intermittent redness and blurring of vision in the right eye for more than one year. The right eye was white, the cornea was normal, but a few cells were present in the aqueous beam. The fundus showed gelatinous exudation on the ora serrata and pars plana ciliaris from the 5 to 8-o'clock position. Gonioscopy revealed conical and mound trabecular synechias inferiorly (fig. 9).

No abnormalities were found in the left eye.

CASE 9

A 57-year-old white woman had been treated for more than one year for a corneal disorder characterized by edema of the epithelium and fine pigmented keratic precipitates. Examination of the fundus revealed inactive healed patches of chorioretinitis from the 4 to 8-o'clock position, immediately posterior to the ora serrata. Gonioscopy showed pillar synechias at the 5 and 8-o'clock positions which were adherent to the scleral spur region.

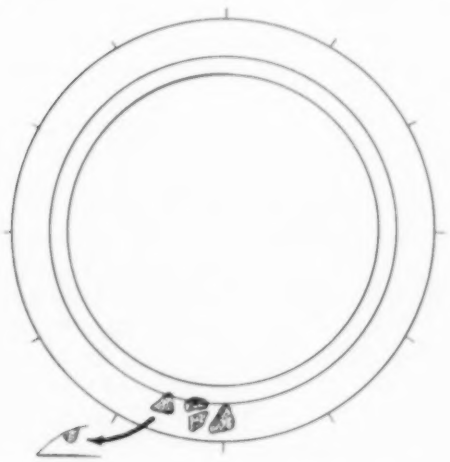

Fig. 8 (Brockhurst, Schepens, and Okamura). Case 7, right eye. Showing trabecular exudates.

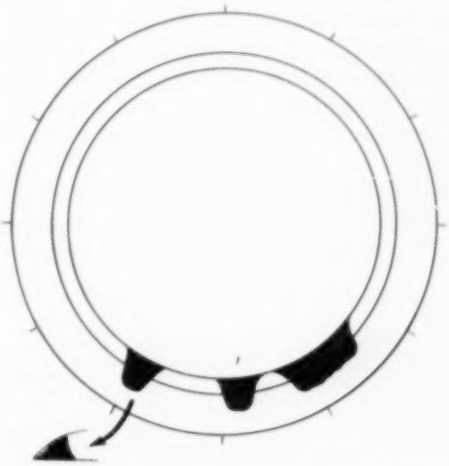

Fig. 9 (Brockhurst, Schepens, and Okamura). Case 8, right eye. Showing trabecular synechias.

Case 10

A 67-year-old white woman, who had lost the use of the right eye because of secondary glaucoma, was being treated for the same condition in the left eye. It showed fine white keratic precipitates, a deep anterior chamber with cells and flare, and posterior synechias which were fine and delicate. No iris nodules were seen. The fundus showed periphlebitis of the superior veins, in the equatorial region, and an area of active choroiditis in the upper nasal periphery, between the ora serrata and equator. Gonioscopy revealed a continuous trabecular band synechia extending from the 6 to 9:30-o'clock position, and a pillar synechia adherent to the trabecula at the 11-o'clock position.

Case 11

A 28-year-old white man had shown an acute fibrinous nongranulomatous iritis in the right eye, one and one-half years previously, which responded to fever therapy and systemic cortisone. During the previous eight months, he had used local cortisone and, on two occasions when this was omitted, the eye became inflamed and irritable. There were a few pigment flecks on the endothelium, about five cells in the aqueous beam, and scattered fine posterior synechias. The fundus showed a white membranous exudate, on the pars plana ciliaris, from the 2 to 5:30-o'clock position. Gonioscopy revealed pillar trabecular synechias at the 7, 7:30, 8, 10, and 1-o'clock positions, and a broad continuous trabecular synechia from the 2:30 to 6-o'clock position. The intraocular pressure was not elevated.

Examination of the left eye was negative.

Case 12

A 50-year-old Negress had a two-weeks' episode of redness in the right eye one year previously. This recurred one week prior to examination and was accompanied by blurring of vision. The intraocular pressure was 48 mm. Hg (Schiøtz). Numerous mutton-fat keratic precipitates were present, as well as intraretinal exudates near the ora serrata in the upper nasal quadrant. Gonioscopy showed ball-shaped exudates in the peripheral iris crypts and on the trabecula. Similar exudates were noted on the iris and lens capsule; these exudates were not readily visible by slitlamp examination, apparently due to the numerous mutton-fat keratic precipitates but were easily seen by goniolens and a hand-held microscope. A pillar synechia adherent to the trabecula was present at the 6-o'clock position.

Discussion

Observations made in the left eye of the patient in Case 3, and the right eye of the patient of Case 5, indicate that gonioscopy is indispensable before an eye examination can be said to be negative for uveitis. In both cases biomicroscopy and fundus examination by direct ophthalmoscopy were negative. However, mutton-fat type of exudates were present on the trabecula in both cases, and in Case 5 similar exudates were found on the ora serrata by indirect ophthalmoscopy.

It is not always easy to classify a given case of uveitis as granulomatous or nongranulomatous when the usual methods of clinical examination are used. Cases 3, 4, 5, and 6 showed none of the changes which generally would indicate a granulomatous type of disease. However, in each case gonioscopy showed mutton-fat type of exudates. If these were visible by slitlamp examination, the cases would be labeled granulomatous by most examiners. It is apparent that some cases of nongranulomatous uveitis may be, in fact, granulomatous, if the presence of large mutton-fat deposits are considered a diagnostic factor and gonioscopy is done to reveal their presence. It should be mentioned that in some cases, for example the left eye of the patient in Case 1, exudates in the angle are associated with mutton-fat deposits on Schwalbe's line. These deposits on Schwalbe's line are visible by slitlamp examination if one carefully observes the back of the cornea near the limbus.

Cases 8, 9, 10, and 11 would ordinarily be labeled nongranulomatous uveitis. It is conceivable that, at one time, each of these patients had mutton-fat deposits in the angle which were later followed by the development of peripheral anterior synechias, only the latter being visible at the time of examination. If this interpretation is accepted, these cases should be called granulomatous.

A common complication of uveitis is the formation of peripheral anterior synechias, which is described by several authors. Junius[5] mentions that swelling of the iris root and anterior ciliary body results in contact of the iris with the back of the cornea, and formation of strands which bridge the angle and then coalesce to form synechias. As cited by Troncoso,[4b] Moreu describes iris nodules from which fine white filaments stretch to the posterior corneal surface, and which later organize to form peripheral anterior synechias. Troncoso[4c] states that "tent synechias are the result of exudates which bind together the iris root and the corneal wall." However, he also states that it is rare to find exudates on the trabecular region where peripheral anterior synechias are often adherent.

François[3] describes the development of peripheral synechias from a massive yellow exudate which filled the inferior angle and overlapped Schwalbe's line. He points out that the exudative changes were confined to the inferior angle, presumably due to the effect of sedimentation. He feels that synechias formed from such exudates are found exclusively in the inferior angle, and result from organization of the exudate, not from swelling of the iris root.

In our observations, however, gelatinous yellow exudates located in the upper quadrants of the angle were found in several instances (Case 1, 2, 3, and 4). Kravitz[2] also describes exudates in the superior portion of the angle. Furthermore, in Cases 1, 2, 3, 4, 5, 6, and 7, herein reported, exudates did not fill the angle but were found on the trabecula. In Cases 1 to 4, these exudates were followed during the course of the uveitis. In Cases 1, 3, and 4, the exudates were large enough to touch the anterior iris surface. Later, with absorption of the exudate, the iris was apparently pulled up toward the anterior wall of the angle, having become adherent to the exudate. Finally, with complete resolution of the exudate, peripheral anterior synechias were present. Thus it is apparent that inflammatory exudates may be deposited on the trabecula, in all quadrants of the angle, and many subsequently lead to the development of peripheral anterior synechias as a result of their adherence to the anterior iris surface.

In the cases reported the anterior chambers were not shallow and the angles were not narrow. No swelling of the iris root was seen. It would be reasonable to feel that a narrow angle with such exudates would be more prone to develop this type of synechia.

It is noteworthy that in this series of 12 cases, abnormalities of the angle were associated with inflammatory changes in the extreme fundus periphery in 11 cases. Case 3 is the only one in which no focus of inflammation could be found beyond that in the anterior segment. In many other cases of posterior uveitis wherein the extreme fundus periphery showed no inflammatory signs, angle abnormalities of the type discussed in this article have not been observed.

Summary

1. Gonioscopic findings are described in 12 cases of uveitis, in 11 of which there was evidence of inflammatory changes in the extreme fundus periphery.

2. A modification of a previously suggested method of recording angle abnormalities is described.

3. Gonioscopy may show active uveitis in eyes where no signs of inflammation are visible either by biomicroscopy or by ophthalmoscopy.

4. Gonioscopy may reveal changes characteristic of granulomatous uveitis, in cases

which otherwise might be called nongranulomatous.

5. A mechanism of formation of peripheral anterior synechias is described.

6. Gelatinous exudates on the trabecula have not been observed in cases showing inflammatory fundus lesions confined to the area which is posterior to the equator.

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HISTOLOGIC METHODS IN THE STUDY OF RETINAL VASCULAR PATTERNS*

IN THE ALBINO RAT

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A. BASIC TISSUE FORMS USED IN STUDY OF RETINA

The last decade has produced many advances in descriptive or morphologic study of human retinal vascular patterns by combining 18th and 19th century whole-mount retinal preparations with newer histochemical reactions. Ballantyne and Loewenstein[1,2] were the first to revive the technique of studying flat, unsectioned, and sometimes unstained retinas. Greeff of Berlin, Dogiel of St. Petersburg, and many other late 19th century ophthalmic investigators used flat retinal preparations, as in the primitive 17th century studies of Leeuwenhoek and the following works of Felix Fontana (1787-1794) and Treviranus (1835-1838). These early observers singularly ignored vascular details in their pursuit of sensory components.

By returning from cut sections to flat preparation, Ballantyne and Loewenstein discovered capillary aneurysms in the retinal pattern of eyes from diabetic patients.

B. ADVENT OF HISTOCHEMICAL TECHNIQUE

Jonas Friedenwald,[3] while involved in an unrelated histochemical problem, discovered that the basement membranes in human retinal vessels and capillaries could be brilliantly and selectively stained by an adaptation of the Hotchkiss[4] and McManus[5-7] techniques with periodic acid.[8] This periodic acid procedure in combination with the Schiff reaction has given to the field of histochemistry its greatest impetus.[9]

The selectivity of this histochemical technique is based on the ability of periodic acid to oxidize the alcoholic group in most carbohydrates and some alpha-amino alcohols, thus producing aldehydes and ketones. A few noncarbohydrate substances, such as the three amino acids, serine, threonine, and hydroxylysine, are oxidized by periodic acid to aldehydes.[10] These aldehydes are classically identified by their ability to yield a red color (Schiff reaction) when exposed to reduced

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fuchsin such as the Feulgen reagent (0.5-percent fuchsin-sulfite solution), Schiff's reagent (0.025-percent leuko-fuchsin solution), or other clear preparations obtained from basic fuchsin and properly described as fuchsin-sulfurous acids.

A few compounds other than aldehydes will stain in the Schiff procedure,[9, 11] but the combined periodic acid-Schiff reaction has been generally accepted for the identification of carbohydrates in tissue.[12] This specificity is not entirely certain[13] and Dr. Ralph Lillie has systematically investigated many normal and pathologic substances in man and laboratory animals to establish their periodic acid-Schiff reaction.[14, 15]

Because of mucoids in the ground substance most connective tissue will stain to some degree with the periodic acid-Schiff technique. Excellent studies of human retinal material by Friedenwald[3] and by Ashton,[16] however, have shown no significant staining except in the basement membranes of the retinal vessels and in the internal limiting membrane. The technique thus seems to offer a most valuable method for studying intact retinal vascular patterns in flat preparations. Investigations of human autopsy material in this fashion have made profound contributions to the understanding of histologic details in both normal and diabetic retinas.[16, 17]

The development of flat retinal preparations in experimental vascular disease of laboratory animals would extend the value of this new approach. Our purpose has been to study this periodic acid-Schiff technique (Hotchkiss-McManus-Friedenwald) in the albino rat and to compare it with other methods for investigating retinal vascular patterns in both the normal albino rat and the alloxan-diabetic rat.

C. Technical methods

The study of retinal vessels in the rat has posed considerable difficulty to most investigators venturing beyond conventional serial sections. The following techniques have been studied and uniformly good results generally have not been achieved.

1. Tangential, oblique, or flat serial sectioning of retina from small blocks a few mm. in diameter.[18]

2. Corrosion preparations after cold-setting methacrylate (Batson) or Neoprene (synthetic chloroprene)[19] injection. Destruction of nonvascular components is usually done with concentrated hydrochloric acid or artificial gastric juice.

3. Mechanical "shake" preparations of unfixed retina in saline to disintegrate other portions of retina.[16] This destroys orientation of vessels.

4. Bulk or whole-mount preparations. Total retinal specimens many be floated in glycerine in glass spheres[2] or subtotal specimens may be salvaged from globes previously embedded and partially sectioned.[13] Trephined "buttons" of full-thickness retina[21] are convenient bulk samples. The periodic acid-Schiff procedure may not be useful on specimens previously embedded in pyroxylin because of age discoloration.

a. *Unstained specimens* cleared in glycerine.[1, 21] Endothelial "cushion" cells particularly located at branches of the retinal vessels are felt by Loewenstein[20] to be most visible in unstained bulk preparations. He has had no success with differential stains in studying this aspect of retinal vessels.

b. *Stained specimens.*

1. Routine or nonselective methods such as hematoxylin and eosin, triosin, scarlet red (may show fatty sheathing[21] of retinal vessels) generally do not yield adequate differentiation of the vessels.
2. Stains to demonstrate intravascular contents, such as benzidine and cyanol* procedures, are inadequate because the smaller vessels and capillaries are usually not well filled.

* Glick, D.: Techniques of Histo- and Cytochemistry. New York, Interscience Publishers, 1949.

3. Analytic or selective staining methods.
   (a) Fast green, which stains the adventitia about the vessels, or orcein, which clearly defines elastic fibrils in reddish-brown color. These are both components of the Kornhauser "quad" stain.
   (b) Silver chloride dichlorfluoresceinate: This demonstrates in pink color the outlines of endothelial cells in capillary walls.
   (c) Acetic-carbol-sudan method of Jackson[23] for frozen sections: Neutral fats stain brilliant orange scarlet; normal myelin stains bright orange.
   (d) Periodic acid-Schiff procedure of Hotchkiss and McManus: Though not consistently reliable, this has frequently yielded good specimens in human material but has posed considerable difficulty in laboratory animal material.
   (e) Laidlaw's diamine silver carbonate to demonstrate reticulum.

c. *Injection specimens.*
   1. India (Higgins or Reeves') ink. This simple procedure has frequently given encouraging results[29] and defines the smaller vascular branches with clarity as seen in Figure 1. Ashton reports this as more satisfactory than many dyes and plastics tried by him[24] and it has been used in previous studies of rat eyes.[25]
   2. Gelatin and blood mixtures followed by hemaglobin stains such as benzidine. Gelatin as a medium has limited penetration and gelatin carbon masses will often fail to fill

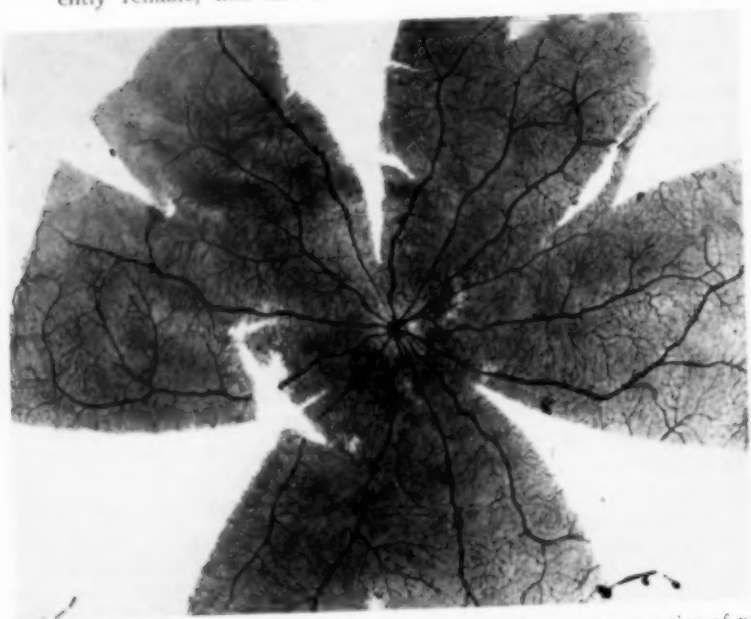

Fig. 1 (Keeney and Barlow). Retinal vascular pattern from whole mount preparation of normal adult albino rat (common carotid artery injection of India ink in the intact animal after distilled water perfusion).

capillaries. Gelatin carmine masses or injections with the Fisher's milk method have been reported to have better penetration and filling.

3. Silver citrate injection followed by counterstaining.[26]
4. Red lead and carpenter's glue.[27] Although inexpensive this is awkward to work with, requires warm glue, and is more advantageous when roentgen studies are to be made.

D. Handling of whole retinal specimens

The fragile rat retina is routinely removed from the fixed globe after sectioning through the pars plana or scleral equator and removing the anterior structures. With the aid of a binocular dissecting microscope and underwater technique the retina is both lifted and flooded from its bed with forceps and a fine stream of water from a tuberculin syringe and 27-gauge needle. The needle point is generally sufficient to free the retina at the optic nerve and maintain retinal continuity.

The rat retina is too large and spherical for transfer to usual albumined slides. Even with the aid of several radial incisions to facilitate flattening the retinas generally will not adhere to the slides through multiple procedures, and the egg white itself contains enough carbohydrate to react in the periodic acid-Schiff stain. To improve handling we have devised perforated end, glass cylinders about three inches long made from inexpensive one-fourth inch laboratory tubing. The free retina in such a handling tube is easily transferred through an infinite number of operations without touching the tissue itself (fig. 2). Slide mounting of the specimen does require radial incisions to afford flattening and should be deferred until the middle of the last dehydration procedure. Final clearing is done on the slide.

Fig. 2 (Keeney and Barlow). Glass handling tube with small opening at lower end and large opening at upper end as used to carry intact retinas through staining procedures.

E. Experimental studies with the Hotchkiss-McManus-Friedenwald techniques

Because of the ease in tracing vascular continuity in flat preparations, and because of the sometimes dramatic demonstration of basement membranes through the vascular system with periodic-acid techniques, these procedures have been particularly pursued. Application of the Friedenwald modification[3] to the albino rat retina has in our hands consistently yielded intense red-purple staining of the retinal background and thereby obscured most of the smaller vascular radicles.

Only larger retinal vessels about the posterior pole could be demonstrated by adhering to the Friedenwald procedure. Similar, intense red-purple staining has been studied by Lillie in the acromeres or outer segments of the rods in guinea pig, dog, sheep, and rabbit retinas. Histochemically, Lillie has ascribed this reaction to one of the lipoid substances long known to be in the rods and probably a galactolipo-protein complex. He found this to be quite difficultly soluble in organic solvents and rendered more insoluble by formaldehyde and chromates. Lillie recommends fixation in hot chloroform and methyl alcohol to reduce lipid staining.[28]

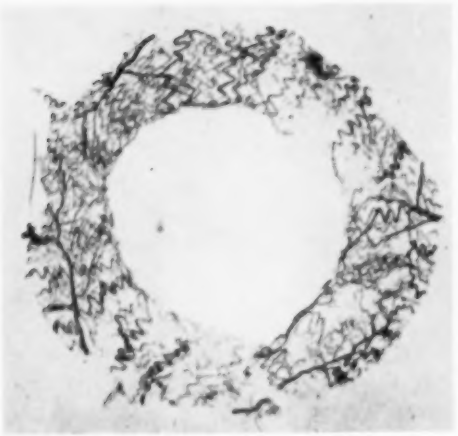

Fig. 3 (Keeney and Barlow). Whole mount preparation of normal adult albino rat iris (common carotid artery injection of India ink in the intact animal after distilled water perfusion).

These periodic acid-Schiff positive lipids are supposed to be reducible by a few hours of postmortem autolysis or extractable by lipid solvents such as warm chloroform *before* fixation with formalin or Zenker's solution. Fixation in methanol chilled by dry ice to about −80°C. has been reported to facilitate the lipid extraction. In human material, both Friedenwald and Ashton[18] have reduced this problem by carefully brushing off much of the rods and cones with a fine camel's hair brush, thereby reducing the thickness of the whole mounts. The rat retina is so fragile, however, that it is difficult to subject to brushing techniques.

In our hands postmortem autolysis has not reduced the intense purple background stain. We have noted the background stain to be less in rat eyes fixed in Bouin's fluid than when fixed in formalin alone. In an effort to reduce this coloration the time that tissues were allowed to remain in the Fulgen reagent (fuchsin sulfite) was reduced from one and one-half hours down to one minute; similarly, exposure to periodic acid was reduced from 20 minutes down to five minutes (as done by McManus for cut sections[6]), and time in the sulfite wash (to destain) was increased up to periods of several days. Each change was without appreciable effect.

Efforts to destain after completion of the routine Friedenwald technique, by using absolute ethanol and 28-percent ammonium hydroxide in equal parts, produced only transient decoloration. This was associated with pH change in the tissues, because acid alcohol did not destain at all.

Fixation with Bouin's fluid was done by both common carotid arterial perfusion and by immersion. Attempt was made to carry out the Friedenwald routine by intravascular staining rather than by immersion. This was tried after distilled water or saline perfusion, both with and without intravascular fixation. Following intravascular fixation, the passages became porus and allowed extravasation. In-

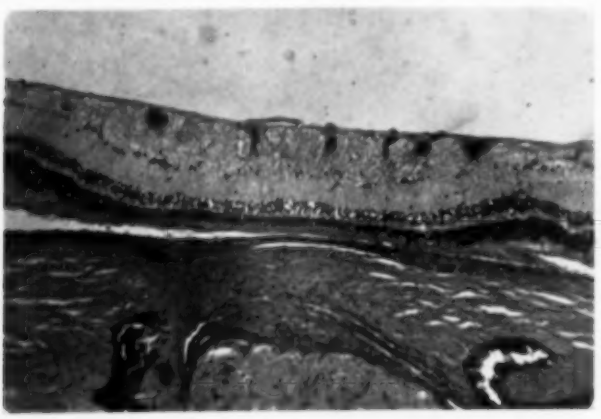

Fig. 4 (Keeney and Barlow). Conventional serial section of normal adult albino rat retina stained with hematoxylin and triosin (larger vessels are seen near inner surface of retina in sections close to optic nervehead).

travascular injection preparations or stains are better when fixation is done after irrigation of the vascular bed, but this technique failed to yield adequate staining of either vessels or ground substance.

At the Wilmer Eye Institute good results occasionally have been achieved on rabbit retinas from Bouin fixed globes, by decoloration with hot coloroform for three to four hours. This is done in an effort to remove Schiff-positive lipids from the rods and cones. In our hands chloroform reflux extraction at 61°C. yielded some yellowish material as indicated by coloration of the solvent but, with the albino rat retinas, still did not prevent the dark background stain.

Analysis of the major reagents involved in the histochemistry of this reaction reveals considerable latitude in their preparation and small variations in their manufacture would not be expected grossly to disturb their action:

1. Periodic acid occurs only in the hydrated form and a series of acids are available depending upon the amount of water which is in combination with periodic anhydride (I_2O_7). These vary from HIO_4 which has been used by Lillie to H_7IO_7. We have used the periodic acid* H_5IO_6 in 0.8-percent solution, as has Friedenwald.

2. The fuchsin should be absolutely decolorized by the action of acid sulfite and the addition of decolorizing charcoal, but the exact chemistry of the basic fuchsin is of little importance according to Conn.[9] Basic fuchsin is actually a combination of three dyes: pararosaniline, rosaniline, and magenta II or new fuchsin. Slight variations in the proportions of these components are unimportant, but the spectroscopic absorption maxima should be about 540 mμ. These dyes are stable for several decades and either of the common salts, acetate or chloride, are useful without altering the Schiff reaction.

3. The Schiff reagent itself has been subjected to many variations in formula† all of which are felt by Gomori[10] to give identical results.

F. Summary

The periodic acid-Schiff technique which has at times given excellent demonstrations of vascular patterns in whole mounted human retinas is not applicable in the albino rat because of intense background coloration. We have been unable to eliminate this by (1) postmortem autolysis, (2) changes in fixation chemicals, (3) variations in staining times, (4) use of ether or boiling chloroform as a lipid solvent, (5) destaining with basic alcohol, or (6) use of the procedure by the intravascular route either before or after fixation. Chemical considerations of the principal reagents involved do not appear to be pivotally critical in their manufacture as long as they are of certified purity.

The vascular pattern in the rat appears most easily demonstrated by common carotid artery injection of India ink in the intact animal following saline or distilled water perfusion. This type of demonstration is illustrated by the retina in Figure 1 or iris in Figure 3. Conventional serial sections as in Figure 4 still offer a most profitable and convenient method of analysis, particularly since the small size of the rat eye enables an entire globe to be mounted serially on only two large slides when cut at 12 micra.

1410 Heyburn Building (2).

* Purchased from The Frederick Smith Chemical Company, Columbus, Ohio.

† Bauer, 1933; deTomasi, 1936; Coleman, 1938; Stowell, 1945; McManus, 1946; Lillie, 1950.

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TUMORS OF THE LACRIMAL SAC*

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INTRODUCTION

Tumors of the lacrimal sac are uncommon. For this reason alone the documentation of six cases presented herewith is worthy of attention. Moreover, such a presentation affords an opportunity to elaborate upon the signs and symptoms exhibited here, as compared with those which have been described in earlier reports. Lastly, the dramatic diagnostic aid afforded by contrast radiography, hitherto very little known, can be illustrated.

Prior to 1938, Penman and Wolff[6] were able to find only 64 cases of lacrimal sac tumor in the world literature. Additional bibliography for this period appeared in the paper of Valieri-Vialeix.[8] Spratt[7] in 1940 reported a case and added several from the literature. Desvignes and Offret[3] reported two cases in 1945 and added several from the literature. In 1951, Ashton, Choyce, and Fison[1] published two cases and reviewed the literature. Duke-Elder[4] in 1952 was able to find 60 cases in addition to those reported by Penman and Wolff,[6] but 26 of them were granulomas. Counting only true neoplasms, the total reported cases including the six presented here must exceed 100.

CLINICAL COURSE

The various features which may be associated with the clinical course of lacrimal sac tumors have been reported. Without attempting to ascribe priority, suffice it to say that epiphora, swelling, and extension outside the sac have been emphasized by Spratt[7]; Barton[2] has called attention to the accompanying dacryocystitis; and Duke-Elder[4] has discussed, besides these, the frequent patency to irrigation even in the presence of a nonreducible swelling. A study of the present six cases has led to the delineation of four stages:

Stage I. Tearing is the only symptom. In this stage irrigation is usually successful in causing a temporary remission of tearing.

Stage II. Simulated dacryocystitis. This may supersede Stage I, so that regurgitation of pus and mucus accompanies pressure over the sac. Irrigating fluid may or may not pass into the nose. This stage may also merge into Stage III, so that pressure over the sac only partially obliterates the swelling which is present in Stage III.

Stage III. Painless, nonreducible swelling in lacrimal sac region. Sometimes Stage I proceeds directly to Stage III without any evidence of dacryocystitis. Irrigating fluid may or may not pass into the nose.

Stage IV. Extension of tumor outside sac.

The various stages shown by our six cases are presented in Table 1.

The unanimous finding of epiphora and the almost unanimous finding of swelling are in conformity with the majority of reports in the literature. It is apparent that nothing in Stage I or II suggests tumor, and Stage III is by no means diagnostic.

DIAGNOSIS

The clinical examination, as shown above, may suggest the presence of tumor. An even stronger piece of evidence may be obtained from diagnostic roentgenology with the aid of contrast media. The final diagnosis, however, depends upon the microscopic examination of biopsy material. The first and last parts of this diagnostic triad are well known. It is the second portion, diagnostic roentgenology, to which I wish to draw attention. Contrast radiography of the lacrimal drainage system is familiar, although not widely employed. The technique of such examinations

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TABLE 1

TUMORS OF THE LACRIMAL SAC

Case	Stage I Epiphora	Stage II Simulated Dacryocystitis	Stage III Swelling	Stage IV Extension
T. C. (carcinoma)	×	×	×	
H. W. (carcinoma)	×	×	×	
C. McD. (carcinoma)	×		×	×
J. S. (lymphoma)	×	×		
E. B. (lymphoma)	×	×	×	
M. E. (Kaposi)	×		×	

has been discussed recently by Milder and Demorest.[5]

Figure 1 shows the normal configuration of the sacs. Figure 2 is a posteroanterior view of the patient, C. McD. As shown by the arrow, there is a suggestion of a rounded mass displacing the lipiodol. Note the oil in the nasal floor. Figure 3, a lateral view on the same patient, shows a rounded tumor outlined in unmistakable manner. Figure 4, a posteroanterior view on the patient, T. C., shows an abnormal oil shadow in the region of the sac. Oil is present in the nasal floor. Figure 5, a lateral view on the same patient, shows a definite semicircle of oil outlining the anterior border of the tumor.

The positive help revealed by these roentgenograms affords additional reason for contrast radiography in lacrimonasal malfunction.

PATHOLOGY

In the cases compiled by Ashton, Choyce, and Fison,[1] about half were epithelial tumors, and of the nonepithelial tumors, most were of mesenchymal origin. Duke-Elder's cases were 60 percent epithelial. While not numerically significant, the present cases were distributed as follows: carcinoma, three; lymphoma, two; Kaposi sarcoma, one.

The patient, T. C., showed a cylindric celled tumor which took the form of an inverted papillary structure. Since the basement membrane was everywhere intact (fig. 6) it was called a carcinoma in situ.

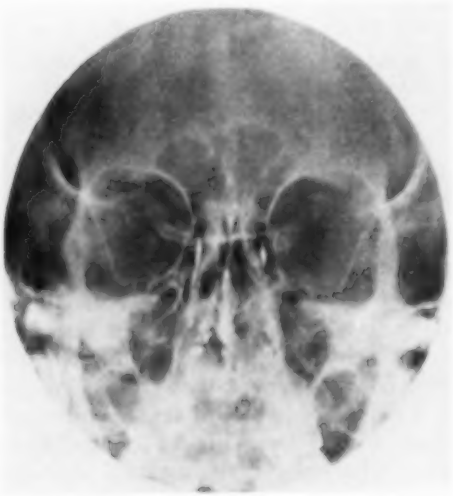

Fig. 1 (Jones). Normal configuration of the lacrimal sac.

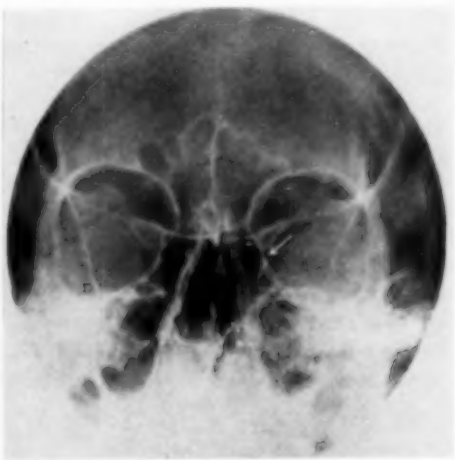

Fig. 2 (Jones). C. McD. Caldwell view. Oil shadows suggest the dome and lateral wall of the mass.

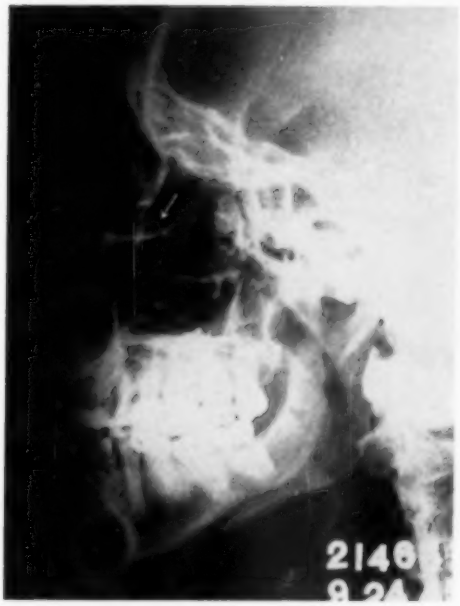

Fig. 3 (Jones). C. McD. Lateral view. Arrow indicates rounded oil shadow.

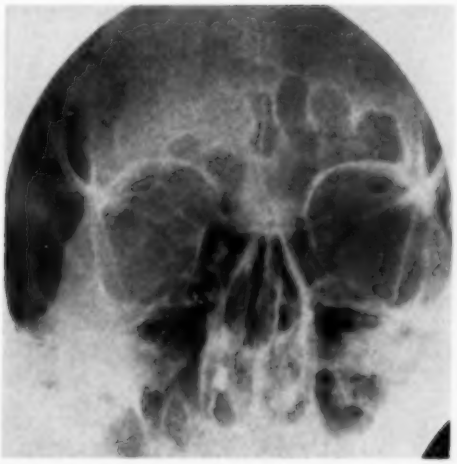

Fig. 4 (Jones). Abnormal oil shadow in the region of the lacrimal sac.

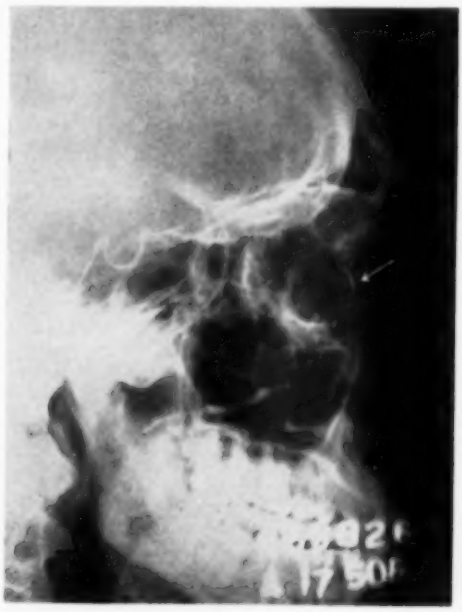

Fig. 5 (Jones). T. C. Rounded anterior border of mass outlined by lipiodol.

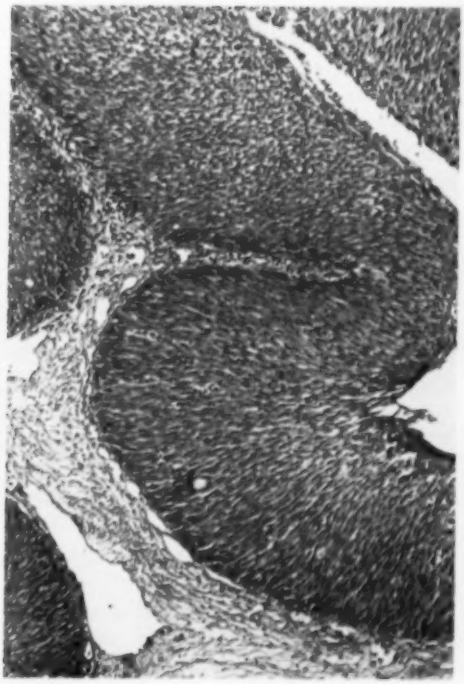

Fig. 6 (Jones). Cylindric cell tumor. Basement membrane is intact. Carcinoma in situ. (T. C.)

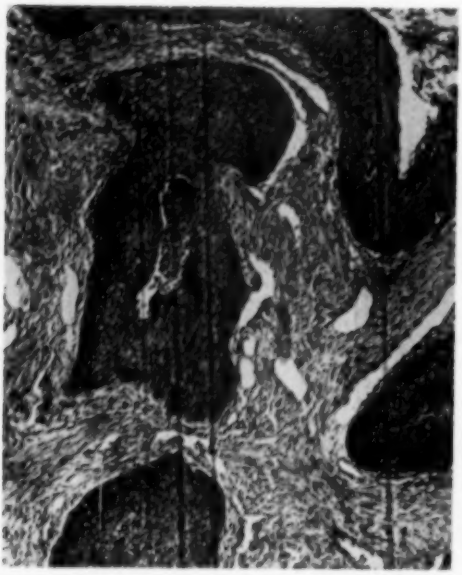

Fig. 7 (Jones). Invading epithelium. Horn formation. Squamous-cell carcinoma, grade II. (H. W.)

The tissue sections of the patient, H. W., showed cords of epithelial cells invading deeply. Figure 7 shows attempted horn formation but without keratinization of the center. The degree of differentiation and the amount of keratinization led to a classification as squamous-cell carcinoma, Broder's Grade II.

Figure 8 represents the microscopic picture of the squamous-cell carcinoma from the lacrimal sac of the patient, C. McD. Keratin formation was very scanty and the cells exhibited marked dedifferentiation. Local and regional metastases showed the same picture.

The histopathology of tissue from the sac of the patient J. S. was that of a follicular type lymphoma. The follicles were poorly formed. Figure 9 shows the lymphocytes and mature reticulum cells in an enlarged field in one of the follicles.

Figure 10 shows the immature reticulum cells from the patient, E. B. The large, vesicular nuclei with well-marked borders are easily discernible, although their cytoplasm is less distinct. The diagnosis was lymphosarcoma, reticulum-cell type.

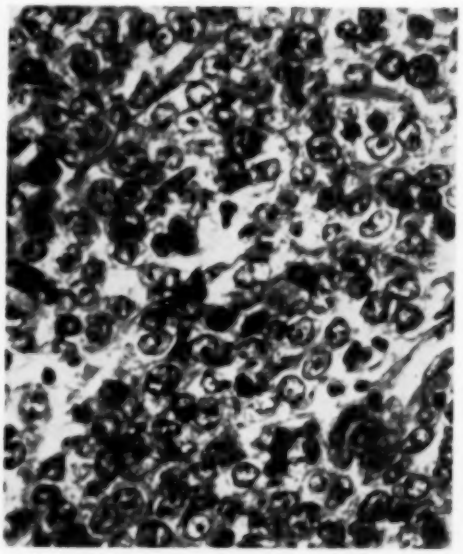

Fig. 8 (Jones). Marked dedifferentiation of cells. Little keratin. Squamous-cell carcinoma. (C. McD.)

The patient, M. E., had Kaposi sarcoma elsewhere, and the section of tissue from the lacrimal sac (fig. 11) shows several new capillaries with large endothelial cells. The bulk of the tumor, however, was of the fibroblastic type.

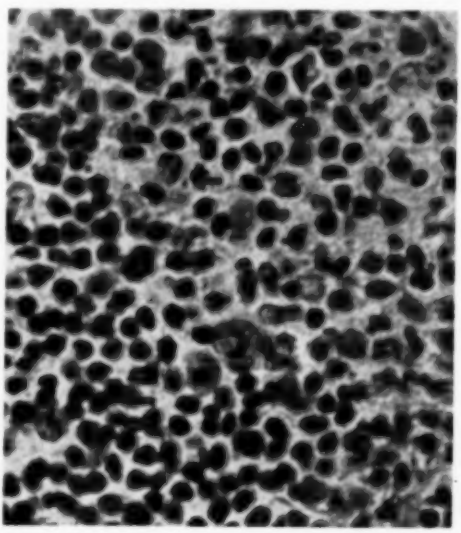

Fig. 9 (Jones). Lymphocytes and mature reticulum cells. Follicular type lymphoma. (J. S.)

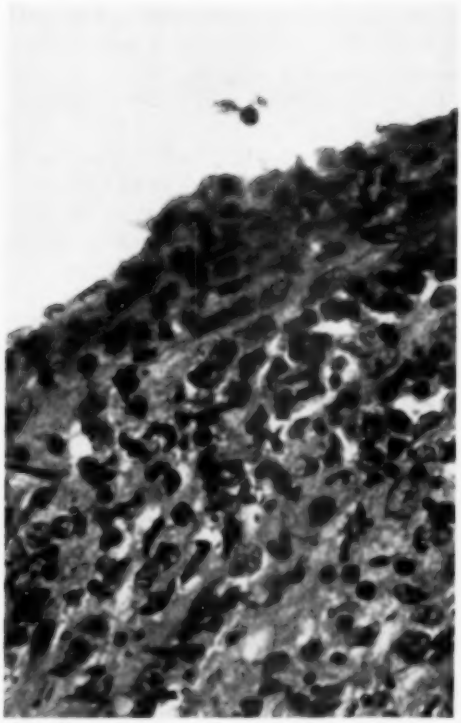

Fig. 10 (Jones). Immature reticulum cells with large vesicular nuclei. Lymphosarcoma, reticulum-cell type. (E. B.)

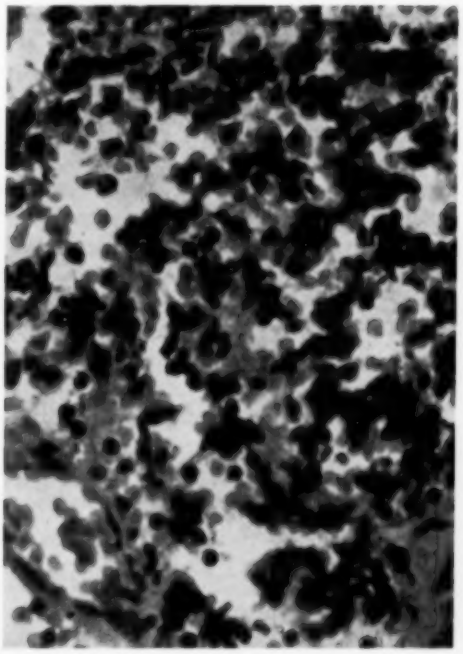

Fig. 11 (Jones). Large endothelial cells forming new capillaries. Kaposi sarcoma. (M. E.)

Treatment

It is agreed by all authorities that complete excision before extension outside the sac is curative. In the case of lymphomas, radiation alone may be sufficient, but generally radiation is employed as an adjunct after excision. Once extension outside the sac has occurred, excision may require the services of neurosurgeon, rhinologist, and perhaps plastic surgeon. Postoperative radiation in the latter group is employed to lessen the chance of recurrence.

Case presentations

Case 1

T. C., a man, aged 45 years, had a two-year history of tearing and regurgitation of mucus on pressure over the right sac. Irrigating fluid passed freely. A firm, nonreducible swelling was present in region of the right lacrimal sac. Contrast radiography revealed a rounded mass in the sac. A dacryocystectomy was performed. The pathologic diagnosis on the specimen was carcinoma in situ.

Case 2

H. W., a man, aged 42 years, had a three-year history of chronic lacrimonasal obstruction on the left, with tearing, and experienced temporary relief from irrigations. For two months prior to operation a tender, nonreducible mass was present. A dacryocystectomy was performed. The pathologic report on the specimen was squamous-cell carcinoma, Grade II.

Case 3

C. McD., a woman, aged 25 years, had a one-year history of lacrimation on the left. Surgery for dacryocystitis had previously been performed with relief. For four months a swelling had been present in the left side

of the neck. A mass in the left lacrimal sac region did not reduce on pressure, nor did pus regurgitate. Irrigating fluid passed through freely. Contrast roentgenograms showed a rounded mass in the left lacrimal sac. A dacryocystectomy and excision of cervical nodes was done. Both revealed squamous-cell carcinoma. Radiation was given. The patient was alive at six months' follow-up.

Case 4

J. S., a man, aged 32 years, had a two-year history of recurrent dacryocystitis on the left. A reducible swelling was present. Pus regurgitated. Irrigation was blocked. A dacryocystectomy was performed. The pathologic report was follicular type lymphoma.

Case 5

E. B., a woman, aged 63 years, had a one-year history of right dacryocystitis. A nonreducible mass was present. Irrigation was obstructed. A dacryocystectomy was performed. The pathologic report was lymphosarcoma, reticulum-cell type.

Case 6

M. E., a man, aged 63 years, had a 10-year history of skin angiofibrosarcoma (Kaposi). For one year tearing was present on the right. A nonreducible swelling was present. Irrigation was obstructed. A dacryocystectomy was performed. The pathologic report was Kaposi sarcoma of the lacrimal sac.

Summary

Six cases of neoplasm of the lacrimal sac are presented.

The clinical and pathologic features are analyzed in detail.

The striking diagnostic aid afforded by contrast radiography is illustrated and emphasized.

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OCULAR CHANGES IN PERIARTERITIS NODOSA*

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INTRODUCTION

More than a hundred years ago, in 1852, K. v. Rokitansky described a clinical picture under the name of "aneurysmatic diathesis" which later was recognized by other observers who re-examined his cases (H. Eppinger, Sr., and R. Maresch) as the same disease which Kussmaul and Maier described in great detail as "periarteritis nodosa." More than 40 years later, in 1899, periarteritis nodosa appeared for the first time in ophthalmologic records, when P. Müller briefly mentioned that in the histologic examination he "also found periarteritic changes in the blood vessels of the retina." It is interesting to note that in the ophthalmoscopic examination the eyeground was normal. In 1926 F. Christeller reported that he had found periarteritis nodosa affecting the blood vessels of the choroid in a histologic specimen. The patient suffered from periarteritis nodosa and developed an albuminuric neuroretinitis.

Since that time the clinical observations and the results of the anatomic examinations of more than 30 patients have been published. This is still a small number of cases compared to the experience of the general pathologist whose results are based on some hundreds of observed cases.

A small survey conducted for that purpose showed that this is partly due to the fact that the eyes are not always affected, even if the disease occurs in its generalized form. The main reason, however, seems to be that the eyes are only rarely subjected to an anatomic examination, since often enough there are no clinical symptoms, even if the eyeball is affected by periarteritis nodosa.

This is confirmed by my own observations, as well as those made by Goldstein and Wexler, on the one hand, and v. Herrenschwand, on the other.

In many other cases it was impossible to examine the eyes anatomically, even though the clinical observation of the patient showed pathologic changes in the eyes. This makes it impossible to establish beyond a doubt the connection between periarteritis nodosa and many other noteworthy clinical observations.

OPHTHALMOLOGIC FINDINGS

We must keep in mind that the clinical ophthalmologic findings in periarteritis nodosa show a great diversity. According to our present state of knowledge of this disease, the changes observed may be divided into three groups:

1. Changes caused by a local periarteritis nodosa of the eye.
2. Changes that belong to the sequelae of periarteritis nodosa of the vascular system.
3. Active tissue changes, which according to G. B. Gruber "may develop in addition to periarteritis nodosa, perhaps from the same cause, common to both, or even quite independently from periarteritis nodosa."

The known cases of periarteritis nodosa cannot always be grouped into one of the three classes mentioned.

Thus Middleton and McCarter, Spiegel, Gjertz, Nordloew, and Svenmar, as well as Boeck, have seen cases of scleritis with periarteritis nodosa, which could be interpreted on the basis of anatomic examinations (Boeck, F. v. Herrenschwand, Nover, as well as Gjertz, Nordloew, and Svenmar), as

* From the II. Eye Clinic, University of Vienna, Head of the Department: Prof. J. Boeck. Presented at the International Symposium on Physiology and Pathology of the Eye, Iowa City, Iowa, September 25, 1954.

sequelae of a periarteritis nodosa of the ciliary arteries.

At times, a chemosis of the conjunctiva of the eyeball was also observed (Boeck, Goldstein, Sampson), which might have been brought on by a periarteritis nodosa of the eyeball, or perhaps of the orbit. Another possibility is that an edema of the conjunctiva may have developed following disturbances of the cardiovascular system which were due to periarteritis nodosa. In both the cases where this observation was made the periarteritis nodosa had produced hypertension. Until now no anatomic examinations of such cases are available and we are thus forced to conjecture.

Harbert and McPherson have observed an extensive circumscribed necrosis of the sclera in a patient suffering from periarteritis nodosa. The diagnosis was made only on the basis of a biopsy of the gastrocnemic muscle. It is possible, in fact even highly probable, that a local periarteritis nodosa of the anterior ciliary and the blood vessels of the sclera may give rise to an extensive necrosis of the anterior portions of the sclera. Since an anatomic examination of the eye could not be carried out in this particular case, no definite statement can be made.

Corneal ulcers were observed in two cases of periarteritis nodosa (Wise). One of the patients also had a severe uveitis, which had been caused by periarteritis nodosa of the eyeball (Ingalls). In the second case the precise connection between the periarteritis nodosa and the development of the corneal ulcer could not be clearly established in the absence of a histologic examination. The case reported by Krahulik, Rosenthal, and Laughlin was that of lagophthalmic ulcer in a nine-year-old girl suffering from periarteritis nodosa. The histologic examination did not reveal a local periarteritis nodosa as an etiologic factor in the development of this corneal ulcer.

Ophthalmoscopic changes of the choroid in patients suffering from periarteritis nodosa appear first as grayish blurred lesions (Moeschlin-Sandoz, Gjertz, Nordloew, and Svenmar, Boeck) which develop later into old, so-called choroiditic foci (Boeck). These lesions belong in the first group. The histologic examinations by numerous authors (Moeschlin-Sandoz, Gjertz, Nordloew, and Svenmar, Boeck) revealed here unequivocal changes of periarteritis nodosa in the choroidal vessels, not only in clinically affected cases but also in clinically normal eyes (Goldstein and Wexler, Boeck, Nover).

It is much more difficult to answer the question, whether or not the iritis found with periarteritis nodosa in the cases examined up to now is an immediate consequence of a periarteritis nodosa of the blood vessels in the iris. In the literature there are only two cases of iritis with periarteritis nodosa. Spiegel could not carry out an anatomic examination. King found a severe iridocyclitis with secondary glaucoma in a patient with generalized periarteritis nodosa. The anatomic examination showed an iridocyclitis and a choroiditis without the changes in the uveal vessels which are characteristic for periarteritis nodosa.

From this it may be inferred that in periarteritis nodosa, iridocyclitis as well as choroiditis may develop without any demonstrable connection with the periarteritis nodosa. However, we cannot exclude the possibility of an affection of the type mentioned by G. B. Gruber. He thinks that the inflammation may have developed in addition to the periarteritis nodosa, perhaps from the same cause common to both.

Inflammation of the uvea in periarteritis nodosa may therefore occur as a consequence of a local periarteritis nodosa, that is one affecting the blood vessels of the uvea. In this case the affection would belong in the first group. On the other hand it could be a disease which develops in some cases of periarteritis nodosa and which has no evident connection with the periarteritis nodosa, so that these cases would belong in the third group.

It is remarkable that pathologic changes

characteristic for periarteritis nodosa were found in the vessels of the iris and ciliary body (Boeck, Goldstein, and Wexler) and yet no clinical symptoms had been observed in these eyes (Boeck). These pathologic changes were often severe and extensive, affecting particularly the larger arterial circle of the iris and also the smaller iris vessels.

Systemic findings

The most frequent finding in ocular periarteritis nodosa is an albuminuric retinitis. A survey of case histories recorded in the literature, which was conducted in 1944, showed that among 90 patients with periarteritis nodosa, in whom the eyegrounds were observed, 21 had an albuminuric retinitis or a hemorrhagic neuroretinitis with retinitic patches. All of these patients had albuminuria and high blood pressure. The duration of the disease had been at least three months, sometimes even more than a year, and in a few instances several years. It should also be stressed that most patients were male; this corresponds well with G. B. Gruber's statement that periarteritis nodosa has been observed three or four times more often in the male than in the female.

As early as 1926, G. B. Gruber wrote a detailed article on the problem of the causal relationship between periarteritis nodosa, the concomitant kidney disorder, and the development of an albuminuric retinitis. (v. Herrenschwand, Boeck, Goldstein, and Wexler have also pointed out the high incidence of albuminuric retinitis with periarteritis nodosa.) He only states that he found a periarteritis nodosa of the choroidal vessels but fails to give a more detailed description. It is even more regrettable that he says nothing about the anatomic examination of the retina.

As already mentioned, Kernohan and Woltmann also found a periarteritis nodosa of the choroidal vessels in the histologic examination of their patient, who was suffering from a generalized periarteritis nodosa and developed an albuminuric retinitis. Here, too, the writers fail to give a precise description of the details of their findings.

Occurrence of retinal detachment

In a number of cases with a clinically and anatomically diagnosed generalized periarteritis nodosa a retinal detachment occurred (Arkin, Bau, Boeck, Goldstein, Herson, and Sampson, Kernohan and Woltmann, Middleton and McCarter, Moeschlin-Sandoz). In none of these cases could a histologic examination be performed at the time of the detachment. For that reason it is impossible to answer definitely whether or not this detachment is caused by a local periarteritis nodosa of the choroidal vessels with a subsequent exudative detachment of the retina.

This has been described for exudative choroiditis without periarteritis nodosa, or Harada's disease (Harada, Nakamura, Salus, Rados, Rubino, et al.). After the spontaneous re-attachment of the retina, Moeschlin-Sandoz found unclearly defined, whitish foci, "as in miliary tuberculosis," as well as a papilledema. The anatomic examination showed a periarteritis nodosa of the choroid. This was also found by Kernohan and Woltmann in their patients. After the retina had spontaneously become reattached, Boeck and Goldstein saw what is generally called retinal striae, as well as clearly circumscribed foci, both white and pigmented, resembling choroiditic foci. Bau also observed in patients with a periarteritic nodosa an acute choroiditis and the development of a retinal detachment.

These authors (Bau, Moeschlin-Sandoz, as well as Boeck and Goldstein) describe the retinal detachment in their cases of periarteritis nodosa as an exudative detachment, caused by an extensive periarteritis nodosa of the choroidal vessels. Likewise Moeschlin-Sandoz, Sampson, Kernohan and Woltmann were able to perform an anatomic examination. What they found, though only after a reattachment of the retina, was a periarteritis nodosa of the choroidal vessels. This supports the assumption that an exudative de-

tachment was here caused by a periarteritis nodosa of the choroidal vessels. Thus, the retinal detachment observed in these patients should be viewed as a consequence of a choroidal periarteritis nodosa, which would allow us to classify these changes as belonging in the first group; that is changes due to local periarteritis nodosa.

One case, however, was observed by Kernohan and Woltmann (Case 5) which raises the possibility of another interpretation, in spite of the fact that the writers actually found a periarteritis nodosa of the choroidal vessels on anatomic examination. An alternative interpretation is possible because this patient was already affected with an albuminuric retinitis before the onset of the retinal detachment.

This leaves open the possibility of a causal relationship between the retinal detachment and the pre-existing albuminuric retinitis, since retinal detachment may also occur in albuminuric retinitis without periarteritis nodosa. Notwithstanding the fact that in the overwhelming majority of cases where a periarteritis nodosa is complicated by a retinal detachment the latter is caused by a choroidal periarteritis nodosa, cases do seem to occur where this retinal detachment is a consequence of the albuminuric retinitis.

Anatomic findings

No detailed reports on anatomic examinations of albuminuric retinitis with periarteritis nodosa were available until the appearance of the reports by Friedenwald and Rones, and Boeck. Changes in the retinal vessels characteristic for periarteritis nodosa could not be found in any of these cases. The examination showed albuminuric retinitis which could in no way be distinguished from the anatomic picture found in other cases of albuminuric retinitis. Both patients had a periarteritis nodosa of the choroidal vessels and Boeck observed a conspicuous abundance of pseudoxanthoma cells in the diseased choroidal vessels. The same phenomenon has been observed in a number of cases of periarteritis nodosa, particularly when the blood vessels of the central nervous system were affected (Brenner, Wholwill, Richardson, Hampel, Kimmelstiel, Runge and Melzer).

Taking into consideration the clinical findings recorded in the literature and the anatomic examinations performed by Friedenwald and Rones and by Boeck, the conclusion seems warranted that periarteritis nodosa of the choroidal vessels cannot be the immediate cause of an albuminuric retinitis. In the 25 case histories of patients with periarteritis nodosa and albuminuric retinitis, it was found that all the patients, without exception, had high blood pressure and casts in the urine.

This circumstance alone was sufficient to lead G. B. Gruber and others to believe that the albuminuric retinitis occurring with periarteritis nodosa should not be interpreted as a local periarteritis nodosa of the eye, but as a consequence of the changes in the general circulation which give rise to grave disorders of the blood vessels, particularly those of the kidney.

Friedenwald and Rones and Boeck were then able to prove conclusively on the basis of anatomic examinations that the albuminuric retinitis in periarteritis nodosa does not constitute a manifestation of ocular periarteritis nodosa. The albuminuric retinitis is here rather a sign of the serious effects of the general disease on the kidney and the circulation.

Case report

Let me touch briefly on an interesting observation in this field.* A 39-year-old patient, who had suffered from appendicitis and repeated attacks of tonsillitis, as well as an extensive eczema of both legs, eight years before the outbreak of his present disease, developed pains in his joints after furunculosis. Following these pains there were rises

* The complete case history, as well as the detailed findings, were published by D. Griesbacher: Wien. klin. Wchnschr., **61**:326, 1949.

in temperature and a tonsillectomy brought only temporary relief. Since there was a suspicion of endocarditis he was treated with penicillin without success. The high temperatures remained practically unaffected. His blood pressure rose. In his urine red blood cells and casts appeared; as the disease progressed the protein content of the urine gradually increased. The amount of nonprotein nitrogen in his blood rose to 205 mg. percent.

The eyeground was normal at first but later on a typical albuminuric neuroretinitis developed. The fleeting pains in his joints, a neuritis which had been present at the onset of the disease, the vague temperatures, the severe kidney disorder, and the high blood pressure aroused the suspicion of periarteritis nodosa. The diagnosis was later confirmed by biopsy. The patient gradually wasted away and, after the disease had lasted a little more than a year, he developed uremia and died.

The autopsy showed a typical recrudescent periarteritis nodosa with both recent and healing foci in the medium-sized and small arteries of all organs.

The eyes were first fixed in Orth's mixture, then imbedded in celloidin and cut horizontally. The serial sections of the eyes showed a number of typically affected arteries within the choroid. The diseased blood vessels were almost exclusively in the region of the posterior pole, close to the entrance of the optic nerve. There were no diseased blood vessels in the iris, the ciliary body, nor the anterior portions of the choroid.

In the arterial walls the media was seen to be destroyed by a fibrinoid necrosis; the adventitia showed a very dense cellular infiltration (fig. 1). There were some vessels in which the whole wall was replaced by the fibrinoid necrosis. The latter also filled the lumen, so that the blood vessels, when viewed in cross section, appeared as little discs stained with eosin.

The choriocapillaris showed characteristic pathologic changes in several places (fig. 2).

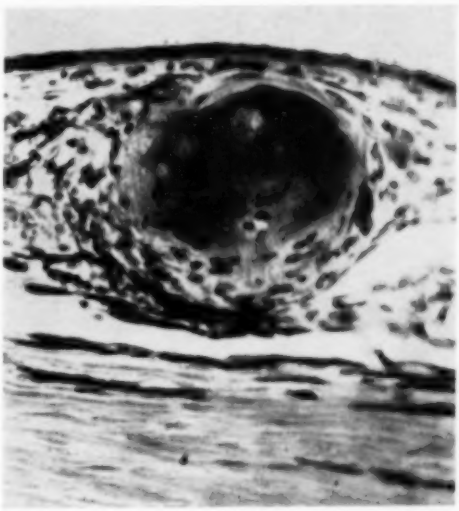

Fig. 1 (Boeck). Extensive fibrinoid necrosis of a choroidal artery, involving the entire vessel wall. (Fixation in Orth's mixture, hematoxylin-eosin, ×180.)

Foci were found in which the capillary walls were completely replaced by fibrinoid necrosis, so that they appeared as little discs or rings of uniform red color. In some areas there was an encroachment of the fibrinoid necrosis of diseased arterioles on the adjacent capillaries (fig. 3).

The tissues surrounding affected areas contained cellular infiltrates identical to those in the walls of diseased arteries. The pigment epithelium covering these areas was swollen in many parts, partly proliferative, and, in some parts, had shed off in autolysis. A few arteries had become transformed into a granuloma consisting of fibroblasts and histiocytes, with only a scattering of round cells (fig. 4). In some of these vascular granulomas it was possible to discern traces of fibrinoid necrosis (fig. 5).

The blood vessels of the retina were free of the disease. The retina presented the typical picture of an albuminuric retinitis with a marked edema of the papilla. The outer layers of the retina were autolytic. This was also true for many areas of the pigment epithelium.

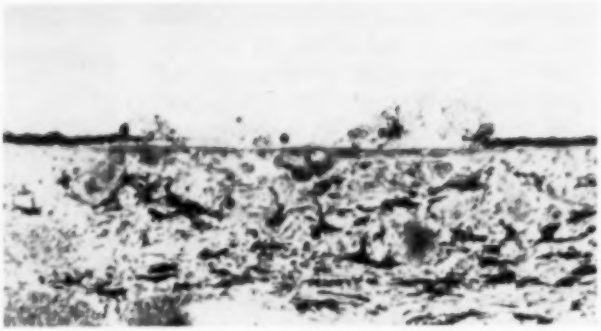

Fig. 2 (Boeck). Fibrinoid necrosis of the choriocapillaris, with changes in the pigment epithelium. (Fixation in Orth's mixture, hematoxylin-eosin, ×120.)

The observation just described also proves the fact, which is corroborated in the literature, that the albuminuric neuroretinitis in periarteritis nodosa is not caused by a local periarteritis nodosa but is rather a consequence of renal and circulatory damage caused by the systemic disease.

Discussion

In this case, as well as in the case observed by Friedenwald and Rones, there existed a typical neuroretinitis, without any other changes in the eyeground.

In one of my own cases a patient suffering from periarteritis nodosa and albuminuric retinitis revealed features which must be interpreted as symptoms of a local periarteritis nodosa. In the periphery of the eyeground grayish-white foci with blurred outlines were seen with the ophthalmoscope. These foci were easily distinguishable from the retinitic patches and were assumed to be recent choroiditic areas. In the course of our observations these foci gradually changed into clearly defined, yellowish-white and partly black, pigmented spots. These could be definitely interpreted as the sequelae of an inflammatory affection of the choroid. Thus, apart from the albuminuric retinitis which would fall into the third group, there were also local changes present, namely, a periarteritis nodosa of the choroidal vessels.

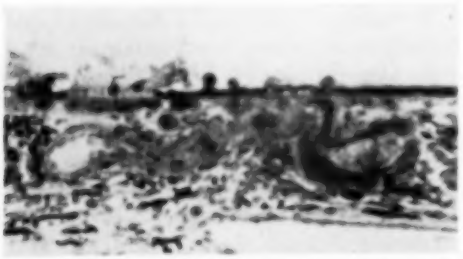

Fig. 3 (Boeck). Fibrinoid necrosis of a choroidal artery and of the choriocapillaris. (Fixation in Orth's mixture, hematoxylin-eosin, ×120.)

This was substantiated later by the anatomic examination. Here we have evidence of different sequelae of periarteritis nodosa occurring simultaneously in the eye—changes which are to be taken as the consequences of a local affection of the eye as well as changes which must be interpreted as sequelae of the serious disturbance of the kidney and the general circulation.

These choroiditic foci can only be seen with the ophthalmoscope if they are not masked by the changes in the retina. This may have been partially the case in the observation just described, where the choroidal foci were confined to the posterior pole.

If an inflammation of the choroid, particularly an acute inflammation of the choroid, is found in a case of albuminuric retinitis, it could perhaps be viewed as an indication of an existing periarteritis nodosa. Let me mention in passing that in patients with periarteritis nodosa and changes in the retina differing from the usual syndrome of albuminuric retinitis, none of the changes typical for periarteritis nodosa could be de-

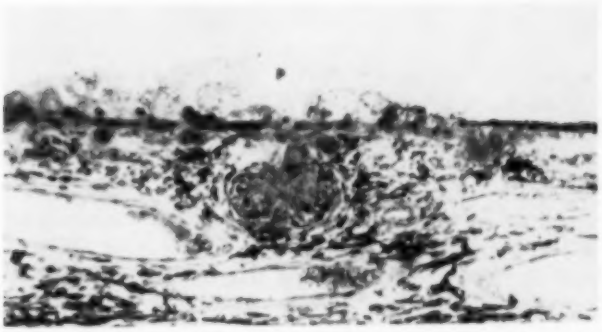

Fig. 4 (Boeck). Fibrinoid necrosis of the choriocapillaris. One choroidal artery shows, in addition to fibrinoid necrosis, a developing granuloma. (Fixation in Orth's mixture, hematoxylin-eosin, ×120.)

tected in the blood vessels of the retina by anatomic examination; a periarteritis nodosa of the choroidal arteries could, however, be demonstrated histologically in several of these cases (Gaynon and Asbury, Goldsmith, Goar and Smith).

There are also records of very rare ocular changes in patients with periarteritis nodosa. Thus, for example, an affection of the central artery of the retina was discovered by v. Herrenschwand in an anatomic examination, and in a clinical examination Bernstein saw an occlusion of the central artery. Goldstein and Wexler had the opportunity to examine a patient suffering from periarteritis nodosa with bilateral primary optic atrophy. The anatomic examination of the eyes showed a periarteritis nodosa of the choroid. A connection between the periarteritis nodosa and the optic atrophy could not be proven. Pupillary disturbances and paralyses of external ocular muscles have also been observed in patients in whom the orbital vessels were affected (Boeck). These findings are particularly noteworthy in view of the frequent occurrence of a multpile neuritis in periarteritis nodosa.

Many attempts have been made to find the cause of this disease, which is confined to the blood vessels, and here again mostly attacks the arteries, taking the form of a circumscribed acute inflammation of the vascular walls. Up to now, all these investigations have failed to bring any positive results and we have to admit that all statements that have been made in this connection are mere assumptions. Many of them are well reasoned to be sure and based on careful and painstaking studies, but they still are far from being proved facts.

Thus, for example, it has been pointed out that the fibrinoid necrosis, which, as we have seen, is such a typical and regular feature of periarteritis nodosa, consists in a patho-

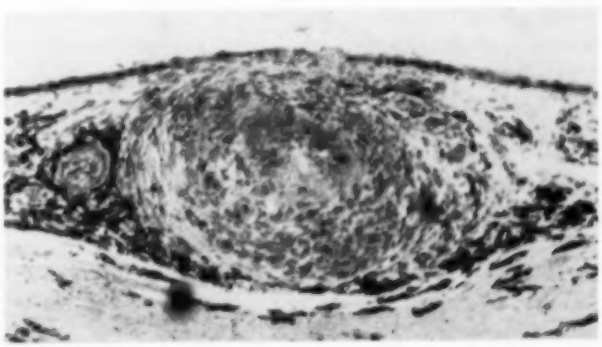

Fig. 5 (Boeck). A larger choroidal artery has been transformed into a cellular granuloma in the center of which remnants of the fibrinoid necrosis are still visible. The choroid is thickened by this nodular granuloma. (Fixation in Orth's mixture, hematoxylin-eosin, ×120.)

logic change of the collagen as found in certain other diseases. The investigations carried out by Klemperer, Pollack and Baehr showed that a necrosis of the same type has also been found in other collagen diseases. Klemperer and his collaborators include disseminated lupus erythematodes, dermatosclerosis, dermatomyositis, rheumatic arthritis, and others, under the name of "collagen diseases." Hollenhorst and Henderson, as well as Vail, have already given detailed consideration to the changes in the eye occurring in the so-called "collagen diseases."

G. B. Gruber has pointed out that the anatomic picture of a hyperergic inflammation, as first described by Roessle, may bear an extraordinary resemblance to the histologic picture of periarteritis nodosa. That is how he interprets the various types of infections, which so often figure in the patients' history.

If he is right, periarteritis nodosa would have to be interpreted as an allergic-hyperergic reaction of the blood vessels, and especially of the arteries, to various damaging agents, with infections taking top rank.

This view seems to be substantiated by a number of experimental studies and anatomic findings. Here I shall confine myself to reference to Klinge and Vaubel's work on rheumatic vascular diseases, as well as the changes in the blood vessels obtained by Masugi in his well-known series of experiments with nephrocytotoxin. Let me also mention the experimental research carried out by Rich and Gregory, as well as the changes Rich was able to detect in the blood vessels following hyperergic reactions to drugs, especially sulfonamides.

Yet, there are still quite a number of morphologic differences between vascular changes precipitated experimentally and the characteristic manifestations of periarteritis nodosa. Only recently Randerath re-emphasized the morphologic changes peculiar to periarteritis nodosa. Also Terrueggen points out the fact that in axis stags, a special type of deer where the disease was first discovered by Luepke, periarteritis nodosa occurs as an endemic disease. This fact of endemic appearance in animals cannot be explained by a hyperergic reaction to various detrimental factors alone.

To date none of the attempts made to find a micro-organism which could cause the disease have met with success. The old view, which goes back to Virchow, that the cause of periarteritis nodosa can be attributed to syphilis, has been abandoned long ago. Many authors suspect that periarteritis nodosa is caused by an organism specific to that disease, mainly because of the resemblance of the clinical picture to that of sepsis.

Taking this assumption as a basis, numerous studies have been made in that direction. To quote some examples, Beitzke and Manges and Baehr have tried blood cultures —with no results. Lamb and Klotz found various micro-organisms, such as streptococci, staphylococci, and also diphtheroid bacilli; however, animal experiments carried out with the organisms cultivated by this method were not successful.

v. Hann, as well as Harris and Friedrichs, was able to produce vascular changes in rabbits by inoculating them with extracts of diseased tissue. Harris and Friedrichs believe that the disease is caused by organisms so small that they can pass through Berkefeld filter N. Arkin agrees with their findings, while Otani rejects them on the basis of experiments of his own which gave negative results.

Starting from his own histologic researches on herpes zoster, Feyrter re-opened the problem a short time ago by raising the question whether periarteritis nodosa is caused by a virus, perhaps even by an organism closely related to the herpes zoster virus.

His hunch was based on the fact that, in his examinations, he invariably found an arteritis within the compass of the affected metamere in herpes zoster. Since in a number of cases the ganglion corresponding to the respective metamere was found to be free of changes (Wohlwill, Wiedner, Feyr-

ter), he believes that herpes zoster is actually a hematogenous inflammation, characterized by capillaritis, arteritis, and, occasionally, phlebitis.

On the evidence of his findings Feyrter maintains that arteritis in herpes zoster is frequently accompanied by fibrinoid necrosis of the vessel walls and quite often cannot be distinguished from the common form of periarteritis nodosa. He was also able to point to cases recorded in the literature where a typical periarteritis nodosa was found as a concomitant of herpes zoster (Wohlwill, Maybaum and Druss).

It is interesting to note that as early as 1920, Meller was able to demonstrate in ophthalmic herpes zoster the presence of an extensive arteritis in the eye in addition to a ciliary neuritis. This arteritis led to the destruction of the elastic lamina. Meller also found another instance of arteritis in herpes zoster in the further course of his investigations.

Feyrter incorporates these findings recorded in the literature, as well as the results of his own investigations, in the theory that herpes zoster invariably gives rise to an arteritis and capillaritis in the segment attacked. The capillaritis is here the manifestation of the inflammation of the peripheral nervous terminal plexus.

In some cases one may even see an arteritis that cannot be distinguished morphologically from the typical periarteritis nodosa. On clinical examination it is also possible to recognize a neurotropy in both diseases, with herpes zoster primarily attacking the ganglion cells, while periarteritis nodosa is more liable to attack the peripheral nervous tissue, presenting the clinical picture of a multiple neuritis.

Herpes zoster is generally assumed to be a disease caused by a specific virus. This would imply that this type of virus infection invariably entails arteritis. The morphologic findings referred to suggest that typical periarteritis nodosa may be caused by a virus, perhaps even by a virus closely related to the herpes zoster virus.

Conclusion

As the researches of the last 30 years have shown, periarteritis nodosa causes a rich variety of changes in the eye, which may lead to quite different clinical manifestations. A few of these manifestations can be traced back definitely to the local periarteritis nodosa of the ocular vessels. Other manifestations, particularly the albuminuric retinitis, which is so frequently found with this disease, are not a consequence of the local periarteritis nodosa. In addition one may also observe changes in the eyes, whose relationship with the existing periarteritis nodosa has not yet been clarified. The clinical pictures which periarteritis nodosa may produce in the eye are of an extraordinary diversity. This is quite in the nature of the disease, which may produce an incredible variety of systemic clinical manifestations. They are very often difficult to interpret, in cases where the rest of the body is affected. Recent investigations have again made it seem highly probable that periarteritis nodosa has a specific etiology.

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Discussion

Frederick C. Bloom (Iowa City): Before discussing Dr. Boeck's paper I wish to extend to him in the name of all here present, the sincerest congratulations on his succeeding Professor Lindner to the chair of the Department of Ophthalmology at the University of Vienna. I personally have all

reason to rejoice that one of my former teachers at the Clinic Meller has now become head of the department.

Dr. Boeck has covered the subject of periarteritis nodosa completely and in a scholarly manner. I have very little to add and my discussion will be limited to a few points of special importance.

Dr. Boeck showed convincingly that periarteritis nodosa may directly involve the uveal vessels but not the retinal vessels. The retina is only involved secondarily when a hypertensive retinopathy develops. This difference between the uveal and retinal vessels may at first seem artificial and surprising. It is, however, easily explained when we keep in mind that periarteritis nodosa is a disease which attacks muscular arteries only. The retinal arteries on the other hand are true arterioles with no continuous muscular sheath in the media. They will, therefore, remain immune to the characteristic changes of periarteritis nodosa.

Dr. Boeck has already discussed some of the involvements of the anterior segment of the eye in this disease. They seem to gain more and more in interest and are probably not so rare as was formerly believed. Among the corneal involvements described are not only ulcers, as mentioned by Dr. Boeck, but also interstitial keratitis and diffuse inflammation. Scleritis and scleritic nodules have been described, but are certainly not so rare as believed. We have seen a couple of such patients in the last year here in Iowa City.

The differential diagnosis of periarteritis nodosa may be difficult. During the last years certain criteria have been established which permit differentiation of the various forms of necrotizing angiitis. Temporal or cranial arteritis is one type of vascular disease that may resemble periarteritis nodosa. However, in temporal arteritis we are dealing with a non-fatal inflammation of cranial arteries. The granulation tissue is here characterized by multinucleated giant cells. Rheumatic arteritis, on the other hand, is usually a complication of a fulminating rheumatic fever. The inflammatory tissue consists here of typical Aschoff bodies. In the so-called hypersensitivity angiitis we are dealing with a widespread, but short-lasting arterial disease. There is a diffuse inflammation, but no true granulation tissue as in periarteritis nodosa.

The etiology of this disease remains unknown. Dr. Boeck mentioned a new and interesting approach. The possibility that periarteritis nodosa and herpes zoster are in some way related seems to me far fetched. The fact that an arteritis may accompany the herpes should not seduce us to reason backward. More experimental data would have to be presented before such a theory could be seriously evaluated.

STUDY OF THE ANTIGENS OF THE CRYSTALLINE LENS*

By immunochemical methods of protein fractionation

J. François, M.D., M. Rabaey,† M.D., R. J. Wieme, M.D., and M. Kaminski, M.D.
Ghent, Belgium

Since Uhlenhuth, in 1903, for the first time directed attention to the particular antigenic properties of the proteins in the crystalline lens, many studies have been carried out in order to throw light on the problem of the organ or species specificity of these proteins, for example, by Hectoen and Schuldof in 1924 and by Woods and Burky in 1933, but none of these have led to unequivocal results.

Many authors, also, have attempted to determine the influence of immunologic factors on the formation of opacities of the lens (Roemer, 1907; Ibsen and Bushnell, 1931; J. François, 1941). The last-mentioned author demonstrated by means of rabbit experiments that congenital cataract may be due to an immunologic phenomenon: the injection of emulsions of lenticular tissue into pregnant rabbits caused specific precipitins to pass into the blood of the fetuses; the contact between these maternal precipitins and the proteins in the fetal lenses gave rise to opacities which were often small and localized, but perfectly visible under the biomicroscope. Although certain forms of congenital cataract may consequently be considered to have a serologic pathogenesis, this cannot apply to cataract in the adult, because the adult lens is impermeable to precipitins.

The antigenic properties of the crystalline lens are also important in other respects. They may contribute, for instance, to the

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study of the various protein fractions of the lens. During the last few years, diffusion techniques have been developed which make possible fractionation of a mixture of antigens. If one realizes the extreme sensitivity and high specificity of precipitation techniques, it will be clear how interesting is their application to the proteins of the lens, of which the fractions were found to be more numerous than was previously believed (J. François, Wieme, Rabaey, and Neetens, 1953 and 1954).

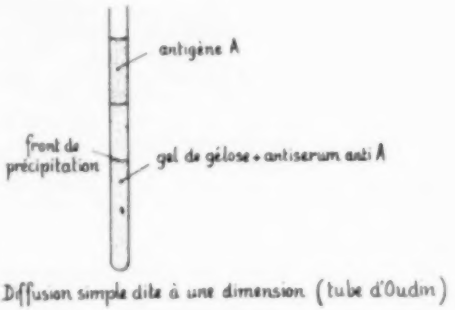

Fig. 1 (François, Rabaey, Wieme, and Kaminski). Simple diffusion.

Immunochemical techniques of protein fractionation

All immunochemical techniques of protein fractionation are based on the differential diffusion of the antigen mixture in an agar gel. When subjected to a pressure which depends on the concentration gradient and directs them toward the lowest concentration, the different constituents migrate at different speeds. The migration rate is dependent on the one hand on the concentration, and on the other hand on the diffusion coefficient, which is a molecular constant; these are the two essential differentiation factors, the constitution of the medium, the temperature, and the time being identical for all components.

Immunochemical techniques have made it easy to follow the progress of the diffusion fronts, much easier than with optic or microchemical methods. It is sufficient to add to the gel medium a reagent which precipitates the proteins from a certain given concentration limit and redissolves them above another limit. So when a mixture of two proteins is used, two precipitation bands may be observed moving at different speeds.

The precipitins constitute precisely such a reagent. The serum in which they are contained is added to the medium before it sets, thereby ensuring homogeneous distribution. The solution to be examined is poured on top. This is the technique of "simple diffusion" proposed by Oudin in 1947: to each component corresponds one moving front (fig. 1).

It is also possible to let the antiserum diffuse from a reservoir: this is the technique of "double diffusion" described by Ouchterlony in 1948. It results in two fronts moving toward each other (fig. 2).

In this way three types of reaction may be observed:

1. The reaction of total identity (type I): if the two antigens are identical, the two front lines which represent the precipitation reaction join up to form one continuous curve.

The reaction of partial identity or crossed reaction (type II): if the two antigens are not identical but similar, possessing common antigenic groups, the heterologous antigen

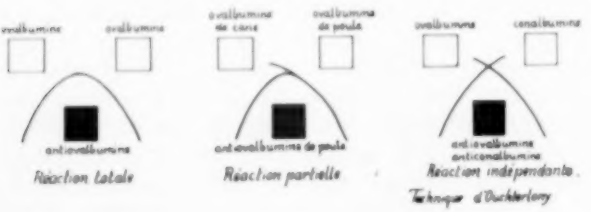

Fig. 2 (François, Rabaey, Wieme, and Kaminski). Scheme of Ouchterlony's double diffusion.

does not attain complete exhaustion of the antibodies corresponding to the homologous antigen; the two lines become joined, but one of them progresses further; this is the homologous reaction.

3. The independent reaction (type III): if the two antigens are completely different, the two lines meet and, after crossing, continue on their completely unaltered courses.

One of us (Kaminski, 1954) has modified Ouchterlony's method (fig. 3) obtaining the advantage of "lesser dispersion of the reactive substances and better localization of the precipitation lines, thereby facilitating comparison and identification. In this way one also approaches as near as possible to a permanent excess of antigen, which renders it permissible, from a theoretical point of view, to presume the antigen concentration constant."

Although the "simple diffusion" technique is quite suitable for mathematical analysis, it is not a quantitative method because of the many intervening factors. For qualitative determination, the "double diffusion" technique is far superior. Therefore we have selected this technique, with the modification of Kaminski.

In the interpretation of the results, the possibility of artefacts should be taken into account; usually the artefact consists of a double line which actually represents only one antigenic system. This doubling is brought about by phenomena of periodic precipitation, as are common with all threshold mechanisms.

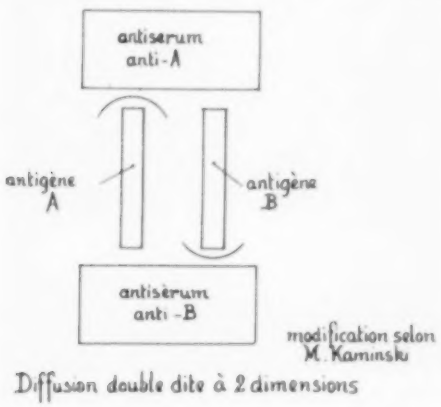

Fig. 3 (François, Rabaey, Wieme, and Kaminski). Technique of Kaminski.

Errors can be avoided by comparing the results obtained at different concentrations or by using a sufficient excess of antigen. At any rate it is certain that a moving line is never an artefact.

Immunoelectrophoresis

The techniques described above do not permit direct identification of the antigens under study, unless it is possible to obtain the various components in a pure state; in that case one can use them for comparison on diffusion plates or carry out absorption of the specific precipitins.

Fractionation of the proteins is, however, often impossible to perform. This is the reason why the immunoelectrophoresis method, developed in 1953 by Grabar and Williams, is so useful. These workers carried out an electrophoretic fractionation in the same milieu where the diffusion was done; then they introduced antibodies following a direction perpendicular to the axis of electrophoretic migration, by diffusion from reservoirs placed alongside the electrophoretic strip (fig. 4). This method "permits of linking together two different properties of proteins: the antigenic groupings and the electric charges."

Personal investigations

We have successively used the double diffusion technique and immunoelectrophoresis. The first results have already been reported by Wieme and Kaminski to the Society for Biological Chemistry (1955).

Materials used

1. *Preparation of the antigen.* We used exclusively total extracts of bovine lenses. After separation of the cortical from the nuclear part, the water-soluble proteins are extracted from both by adding to the material four times its weight of water. In this

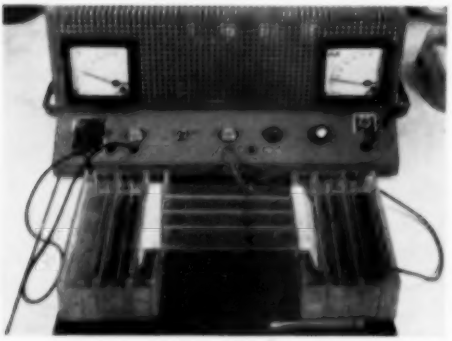

Fig. 4 (François, Rabaey, Wieme, and Kaminski). The four cups filled with the antigenic solution to be studied can be clearly distinguished on the agar plate. They are separated by grooves which receive the antiserum. In the foreground, against a black background, a rubber tube is seen which serves to keep the level in the two electrode labyrinths constant, and the punch with which one makes the holes which are to receive the antigenic solution. In the background one sees the current rectifier (100 to 350 v., 0 to 300 ma.) which allows several plates to be arranged in parallels or in series.

way an extract is obtained which has a protein concentration of about five percent. After centrifugation at 15,000 rpm the solution, which has been prepared under sterile conditions, is placed in 5.0-ml. ampoules and kept in the refrigerator at −25°C. All the antigen, both cortical and nuclear, which we needed for our studies, was prepared at the same time.

2. *Preparation of the immune serum.* Ten young male rabbits weighing 2,000 gr. were selected; five of these were given cortical extract and the other five nuclear extract, in doses of two intraperitoneal injections of 2.0 ml. per week for three months.

One should use the sera with the highest possible precipitin concentration, and only retain those which immediately give a positive ring test. Only two rabbits (No. 6 and 8) fulfilled this condition; it should be noted that both animals belonged to the group immunized with nuclear extract.

The immune serum was obtained by repeated puncture of the auricular artery or vein, which easily yields 10 ml. No disinfectants were used, in order to avoid hemolysis.

TECHNIQUES

1. *Diffusion in agar plates.* We used the double-diffusion method of Ouchterlony as modified by Kaminski. The immune sera, diluted to one third or one fourth in the three-percent agar were brought into contact with the liquid antigens either undiluted or diluted to 0.5 to 0.1 (fig. 5).

2. *Immunoelectrophoresis.* We used the technique of Grabar and Williams, slightly modified, and followed the practical rules applied in the Laboratory for Microbial Chemistry of the Institut Pasteur in Paris.

The plate of photographic glass (13 by 18) is placed flat on a layer of freshly solidified agar. Then a five-mm. layer of 1.5-percent agar in barbital buffer (pH 8.3, μ = 0.05) is poured over it. Before the agar solidifies, strips of filter paper are placed at the

Fig. 5 (François, Rabaey, Wieme, and Kaminski). Double diffusion plate. The immune serum is mixed with the agar; the antigen is liquid. (C) Cortical extract. (N) Nuclear extract.

ends and glass rods are placed so as to mould the cups in which the immune serum is to be received. After solidification, the plate is carefully cut out, keeping intact the agar which covers the paper strips. Then, the cups for the antigen solution are carefully cut out and the glass rods removed.

The protein solution to be analyzed is diluted to 50 percent with three-percent agar (at a temperature slightly below 50°C.) and 0.5 ml. of it is poured into the prepared cups. It is left to cool and covered with a few drops of 1.5-percent agar. The plate is placed on the electrode cups. The arrangement seen in Figure 4 has now been prepared: the electrophoresis may begin: 3 V/cm. for six hours.

Great attention must be paid to the distance between the cups containing the antigen and those containing the immune serum, if one wishes to compare different antigenic solutions. This distance must always be exactly the same and in our experience a distance of six mm. was optimal for a thickness of the agar plate of five mm.

After electrophoresis, the plate is brought to level again and the undiluted immune serum is poured into the appropriate reservoirs. After 24 hours all the fluid is taken up into the agar layer; the plate can now be transported freely or kept under glass at 20°C. in a cool place. It must now be examined daily for the appearance of the precipitation lines, and the progress of these lines is noted for about two weeks. Some lines appear early and move rapidly; they may be gone at the moment when others, of more tardy development, appear. Some of the lines do not move. Study should be made of the morphology of the lines (thickness, crossing at the ends) and many photographs should be taken; simple impression by underwater contact on a positive photographic paper gives good results.

One of us (R. J. Wieme) had the idea of accelerating the appearance of the lines, making them clearer and rendering less critical the distance separating the antigens from the antibodies, by applying an observation described by Tayeau and Faure in 1953; ninhydrin greatly accelerates precipitation in the classical ring-test, while the specificity of the reaction is not at all affected. For this purpose it is sufficient to incubate the rabbit immune serum for one hour with 0.1-percent ninhydrin at 37°C. The mechanism of this modification is unknown; only rabbit serum can be influenced in this manner.

We have compared, on the same plate, the results obtained with treated and with untreated serum. A light-blue halo surrounded the cups containing the treated serum and hindered the taking of photographs a little. This halo disappeared if the plate was left under water for a few hours. At any rate, this slight inconvenience was more than offset by the quicker appearance of the precipitation lines, their greater distinctness, and their tendency to immobility. They could now easily be photographed, whereas with the usual technique they can only be seen during direct, careful observation. We have never seen lines appear which could not also be found with untreated serum if the diffusion distances were carefully selected. Consequently, we are convinced that no artefacts are introduced by this modification of technique. Nevertheless, all our conclusions are based on analysis of results obtained with both the original and the modified method.

Results

I. Total extract of cortex and nucleus of bovine crystalline lens

1. *Double diffusion* (fig. 5). The picture obtained is very complicated. We can distinguish components with rapid diffusion and others with very slow diffusion.

It is clear that the number of fractions is considerably greater than the three known protein fractions, but exact evaluation is very difficult. The antigenic composition of the cortex is very similar to that of the nucleus. The immune serum No. 8 appears to reveal the fractions with rapid diffusion rather poorly.

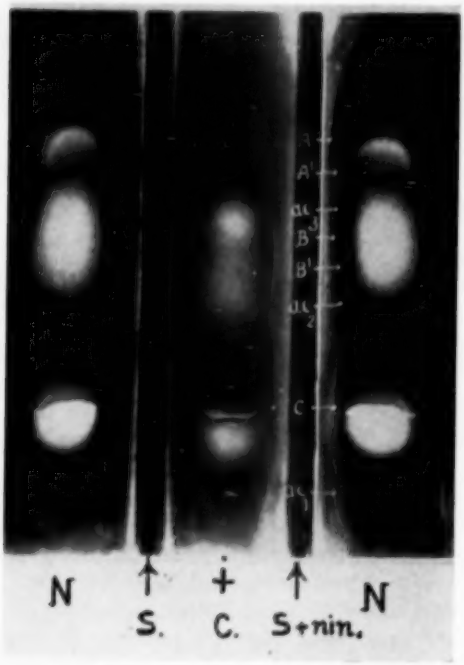

Fig. 6 (François, Rabaey, Wieme, and Kaminski). Immunoelectrophoresis on agar. Comparison of the cortical extract (C) and nuclear extract (N) in contact with antiserum No. 6, treated and untreated with ninhydrin. After immunochemical development, the plate has been subjected to precipitation by dehydration, so as to make the electrophoretic fractions I, II, and III appear.

2. *Immunoelectrophoresis.* With antiserum No. 6, there appeared first the lines A, B, and C, in that order. Later, the lines A′ and B′ appeared at about the same level, and finally the accessory lines ac_1, ac_2, and ac_3, making a total of eight precipitation lines. All these lines, with the exception of ac_3, finally crossed each other. Line ac_3 is only faintly visible, and can only be clearly distinguished on the original plate.

Sometimes the plate shows a supplementary C line; we have not taken this line into account, because it does not correspond to a distinct component, and is probably only an artificial double of line C.

With antiserum No. 8, some of the lines of the B and C group appear, but the picture is highly incomplete. No new lines are observed.

The nomenclature we propose for the various precipitation lines is above all of a practical nature; it allows of their easy identification at the time the plates are read, because it indicates the chronological order of appearance of the lines and their electrophoretical localization at the same time.

On the other hand, it has the disadvantage of using a numbering which is the reverse of that adopted for the electrophoretic fractions: comparison of the precipitation lines and the electrophoretic pictures obtained shows that lines A and A′ correspond to fraction III, lines B and B′ to fraction II, and line C to fraction I. The lines ac_1, and ac_2, and ac_3 do not correspond to any apparent electrophoretic fraction.

It should be mentioned that experiments carried out with fraction I, prepared by a technique already described (1954) and pure electrophoresis, have also revealed the precipitation lines C and ac_1.

However that may be, it is certain that there exist at least eight different antigens in the extract of the crystalline lens. It may further be that immune serum No. 6, although it appeared to be the most complete one, has not reacted with all the antigens present in the watery lens extract.

The possibility of artefacts, we believe, can be excluded. All the precipitation lines mentioned presented a different electrophoretic mobility. Line A lies a little behind A′; in the same way line B is less advanced than B′, and here the difference is even more marked. All lines show up every time with a remarkable reliability, and always in the same places.

They bring to mind the many lines observed on immunoelectrophoresis of human serum, corresponding to the different components which can be demonstrated in fractions which appeared homogeneous on simple electrophoresis. And with regard to this we may add that with the aid of paper electro-

phoresis we have succeeded, partially at least, in completing the fractionation of protein components II and III of the crystalline lens. The shapes of the precipitation lines also deserve our attention; we may mention, for instance, the pronounced thickness of the rapid-diffusion line A and the very typical extreme thinness of line B′; this characteristic makes it easy to find the latter on plates with double diffusion.

Comparison of cortical and nuclear extracts revealed only quantitative differences. All the lines are observed with either extract, but with cortical extract line A appears later, is less sharp, and advances more slowly. The corresponding protein fraction (fraction III), when derived from the nucleus, may consequently be considered to diffuse more rapidly and to have a lower molecular weight. This is a rather surprising fact, since certain observations led us in 1954 to the conclusion that the proteins in the nucleus had a very high molecular weight. The contradiction, however, is only apparent; molecular aggregation and degradation seem to accompany the aging of the lens parallel with the transformation of cortical into nuclear tissue.

II. Total extracts of the crystalline lens of some other animals

We brought immune serum No. 6 (anti-Bovine-crystalline lens serum) into contact with extracts of lenses from several other species of mammals (sheep, horse, pig, man); each time the ring test was immediately and strongly positive, so that it was impossible to distinguish the reactions obtained with the bovine extract from those obtained with the other extracts; species specificity appeared to be wholly absent.

Quite different results were obtained when we subjected these same extracts to immunoelectrophoresis; these findings are shown in the table below.

Immunoelectrophoresis with antibovine-crystalline lens serum:

Extract of lens of	Precipitation lines							
	A	A′	B	B′	C	ac_1	ac_2	ac_3
Sheep	−	−	+	+	+	−	−	−
Pig	−	−	−	−	+	+	−	−
Horse	−	−	−	−	+	−	−	−
Human fetus (6 months)	−	−	−	−	+	−	−	−
60-year-old man	−	−	−	−	+	−	−	−

Figure 7 shows the result obtained when we placed an extract of a human lens (six-months premature baby) in the presence of an antibovine-lens serum: only line C has appeared.

Our observations have taught us that only part of the lens proteins is common to the different species of animals. Organ specificity is exclusively revealed by precipitation line C, which corresponds to electrophoretic fraction I (α crystalline). This fact should not surprise us, since we find this same fraction I in all mammals we have examined in this respect. The other fractions are much more variable from one species to another. They seem to possess species specificity.

Fig. 7 (François, Rabaey, Wieme, and Kaminski). Comparison of nuclear extract of bovine lens with a total extract of human lens (six-month fetus), both in the presence of antibovine-lens serum.

This does not detract from the fact that there may be certain antigenic similarities between certain species of animals; such a similarity exists for instance between sheep and cow as regards fraction II, as shown by precipitation lines B and B′.

Conclusions

Immunochemical analysis (double diffusion in agar gels and electrophoresis) of extract of bovine crystalline lens shows that there exist at least eight different antigens, each having a different electrophoretic mobility. The corresponding precipitation lines, which have been marked with letters, show their order of appearance and of electrophoretic localization: the principal lines are A, A′, B, B′, C; the accessory lines ac_1, ac_2, and ac_3. The lines of group A correspond to electrophoretic fraction III, those of group B to fraction II, and line C to fraction I. The accessory lines do not correspond to any electrophoretic fraction demonstrated up to now.

Between total cortical extract and total nuclear extract there is only qualitative difference.

The addition of antibovine-lens immune serum to extracts of lenses from other mammals caused precipitation of only part of the protein fractions corresponding to electrophoretic fraction I (α-crystalline): only this fraction I possesses organ specificity, whereas the other fractions possess species specificity.

Pasteurlaan, 2.

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GLIOMA OF THE OPTIC TRACT*

Report of a case

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Our search of the medical literature has failed to disclose a primary glioma of the optic tract. We wish to present such a case with visual field studies.

M. T. (U 29774), a 32-year-old white married woman, was admitted to Cleveland State Receiving Hospital June 7, 1954, disoriented as to time, place, and person, complaining of "pains all over" and stating "the top of my head is going to blow off."

While in the Women's Army Corp, she had been hospitalized on several occasions because of frequent "blackout spells," but apparently no abnormalities had been found.

Intermittent headaches had been present for one year and had become constant the three months prior to admission. There had been occasional nausea and vomiting.

Admission physical examination disclosed (only positive findings and pertinent negative findings are recorded):

Blood pressure 125/70 mm. Hg, pulse 88, respirations 20, temperature 37.2°C. Laboratory data were normal. Spinal fluid protein was 15 mg. percent.

An electroencephalogram on June 10, 1954, was interpreted as "abnormal with generalized dysrhythmia and paroxysmal activation with some right temporal lateralization consistent with clinical diagnosis of migraine."

X-ray films revealed a normal sella turcica and normal optic foramina. Ventriculoencephalograms and bilateral carotid arteriograms were normal. The left anterior cerebral artery failed to visualize on two injections.

Successive neurologic examinations disclosed that the patient was periodically disoriented, at times being very co-operative and at others, combative and aggressive. On June 19, 1954, while the patient was co-operative and oriented, there was pain on palpation of the scalp, slight weakness of the right upper and probably of the right lower extremity, decreased deep tendon reflexes of the right side, inversion of the position sense on the right lower extremity, and a question of asterognosis in the right upper extremity.

Ophthalmologic examination revealed the fundi and pupillary reactions to be normal. Wernicke's hemianoptic pupil rigidity test was not made. The right eye had accurate light perception with a suggestion of a temporal hemianopsia by the light field. The left eye exhibited a temporal hemianopsia with macular splitting. Uncorrected visual acuity: right eye, light perception; left eye, 6/9 (fig. 3).

In spite of the psychotic behavior of the patient and the absence of menstrual abnormality, it was felt that the decrease in visual acuity and the field loss suggested a parasellar tumor or optic-nerve glioma (fig. 4).

A right frontal craniotomy was performed under general anesthesia on July 5, 1954. The exploration of the anterior fossa was entirely normal back to the posterior portion of the optic chiasm. However, posterior to the optic chiasm, on the right optic tract, there was an opalescent change in the consistency and character of the tissue (fig. 1).

This involved the medial one third of the right optic tract and had a fingerlike projection extending onto the posterior aspect of the chiasm. A biopsy of this lesion was taken with pituitary forceps. It proved to be an astrocytoma Grade I (fig. 2).

* From the Departments of Neurosurgery and Ophthalmology, Cleveland City Hospital, and the Western Reserve University, School of Medicine.

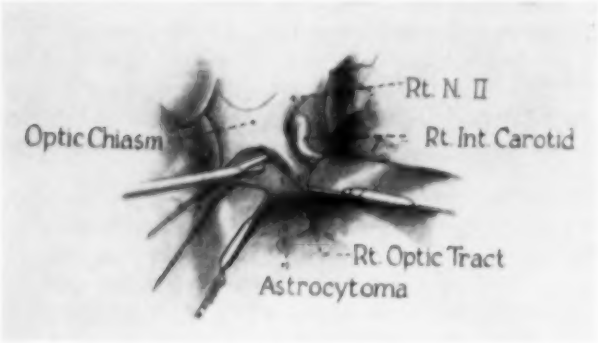

Fig. 1 (Slade and Weekley). Sketch of site of tumor in relation to surrounding structures.

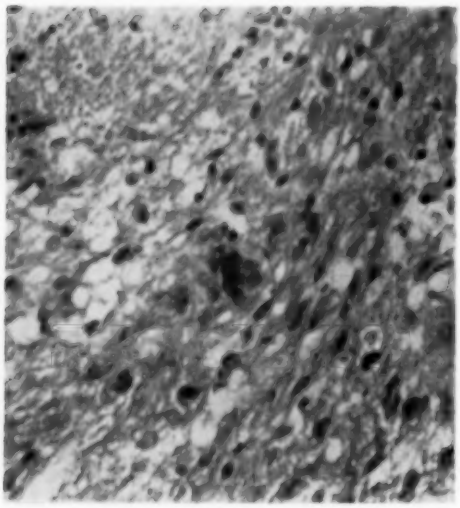

Fig. 2 (Slade and Weekley). Photomicrograph of section of tumor. Astrocytoma Grade I (×185, hematoxylin).

The patient was able to walk unassisted the second postoperative day. The sensorium was still labile. Two weeks after the operation, vision in the right eye was 6/60 and she had a full field for large objects (18 mm./1,000 white). Vision in the left eye was 6/6. Tangent screen outline was normal, but the blindspot was enlarged (fig. 5). The right optic disc showed definite pallor at the margin from the 5 to 8-o'clock position.

Postoperative irradiation was begun on July 12, 1954, and completed on August 30, 1954. Through five portals a total tumor dosage of 5,538 r was administered (fig. 6).

Three months postoperatively, vision in the right eye was 6/60, in the left eye 6/9 (fig. 7). Atrophy of the optic disc in the right eye occupied the lower temporal quadrant. The inferior nasal portion of the left disc was now pale. Tangent screen examination was unchanged. Five months postopera-

Fig. 3 (Slade and Weekley). Visual field on June 17, 1954.

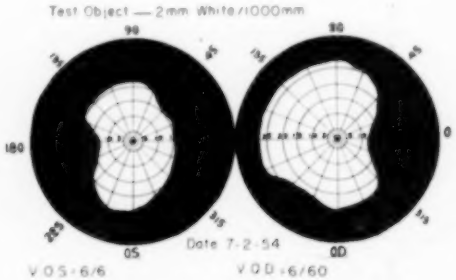

Fig. 4 (Slade and Weekley). Visual field on July 2, 1954.

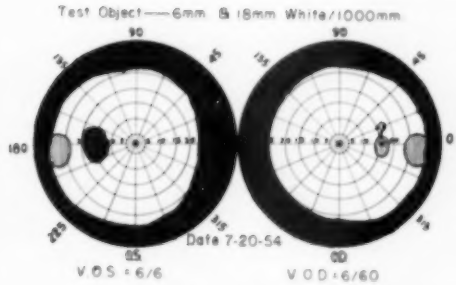

Fig. 5 (Slade and Weekley). Visual field on July 20, 1954.

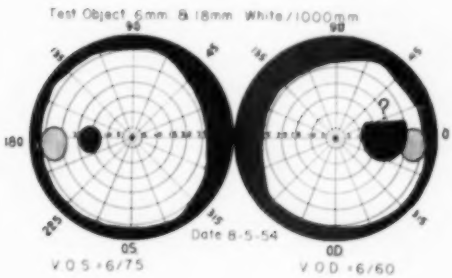

Fig. 6 (Slade and Weekley). Visual field on August 5, 1954.

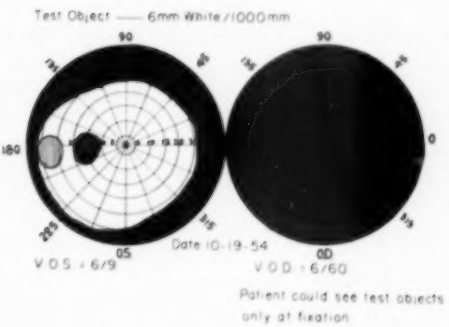

Fig. 7 (Slade and Weekley). Visual field on October 19, 1954.

tively, vision in the right eye was accurate light projection. Vision in the left eye had improved to 6/6 (fig. 8). Psychic changes prevented accurate field examination. The inferior portion of the right optic disc was now white and without capillaries. The inferior pallor of the left optic disc persisted.

Fig. 8 (Slade and Weekley). Visual field on November 19, 1954.

Re-examination in June, 1955, failed to show any changes. The patient was able to walk around by herself but claimed she could not see well enough to read. Her mental status had not improved.

Discussion

In retrospect, the initial amblyopia of the right eye and visual field defect in both eyes were not the result of involvement of the chiasm or right optic nerve by the glioma. Postoperative fields of the right eye were normal in outline using large test objects and the visual acuity was 6/60. We feel that the initial findings (right eye, light perception with a suggestion of temporal hemianopsia by the light field; left eye, temporal hemianopsia) were a combined result of the psychosis, which was unrelated to this tumor, superimposed on the actual visual acuity loss and visual field defect from the right optic tract lesion.

The subsequent optic disc atrophy (right eye, inferior and temporal; left eye, inferior and nasal) indicates the right optic tract as the site of the primary lesion. This confirms the surgical exploration.

Summary

A case of a primary glioma of the right optic tract with secondary invasion of the optic chiasm from behind is presented with visual field studies.

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PERFORATING CORNEOSCLERAL INJURIES*

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A statistical survey[1] of 183 patients treated for perforating ocular injuries at Cook County Hospital appeared in 1945. In the same year, at The Johns Hopkins Hospital, 172 such injuries were studied,[2] and another large series[3] in 1953. Perforating injuries involving the cornea and sclera comprised 8.5 percent of all hospital admissions to the Ophthalmologic Service at the Cook County Hospital from January, 1952, through December, 1953. During this period, 92 patients were hospitalized and treated for corneoscleral lacerations. The present report is based on a study of 292 patients with this type of injury admitted to the Cook County Hospital in the seven-year period from 1947 through 1953. Of this number, 115 eyes were treated during the last three years.

Analysis of cases was undertaken to estimate the importance of some aspects of the injury to the final visual results. Medical and surgical methods of therapy were evaluated. Perforating wounds involving intraocular foreign bodies have been excluded from the studies. Improved end-results in this more recent group of 115 cases may be partly attributed to the introduction of newer therapeutic agents and the refinements of surgical technique.

SCOPE OF STUDY

Patients in our series have been followed variously from one month to three years, with most of them observed for at least one year. Tabulation is based on visual acuity at the most recent examination. Because of differences in the recording of visual acuity on some hospital records, a standard form was adopted.

Injured eyes were studied with regard to: (1) Age and sex of the patient, (2) vision present at the time of admission, (3) interval between the time of injury and institution of therapy, (4) site of the wound, (5) length of the wound, (6) type of object inflicting the trauma, (7) intraocular trauma associated with the injury. Surgical and medical treatment were weighed with a view to ascertaining preferable therapy in the light of postoperative complications and satisfactory results.

1. AGE AND SEX OF PATIENT

Ages ranged from one year to 72 years (table 1). Perforating injuries of the globe occurred more frequently in the younger age group, a third of which took place in patients under 15 years of age. Males were involved three and one-half times more frequently than females. Analysis of the records did not demonstrate a relationship between the age and sex of the patient and the final visual outcome.

2. ADMISSION VISION AND FINAL VISION

Visual acuity was recorded on admission

TABLE 1

AGE AND SEX OF PATIENTS

Age (yr.)	No.	Male	Female
0–5	45	35	10
6–15	48	44	4
16–30	64	51	13
31–45	55	42	13
46–72	43	34	9
Unknown	37	21	16
TOTAL	292	227	65

* From the Department of Ophthalmology, Cook County Hospital, Chicago. Presented before the Chicago Ophthalmological Society, March 21, 1955.

TABLE 2

ADMISSION VISION AND FINAL VISION

Admission Vision	20/20 to 20/200	Final Vision				
		20/200 or less	Unknown	Blind Eyes	Removed Eyes	Total
From 20/20 to 20/200	19	2	0	0	0	21
Less 20/200 to finger counting	19	5	2	2	5	33
Light projection to blind	17	5	6	19	134	181
Vision unobtainable	19	8	11	2	17	57
TOTAL	74	20	19	23	156	292

to the hospital and prior to any treatment. In about 15 percent of the patients, this information was unobtainable because of age, intoxication, or poor co-operation, as indicated in Table 2. In a few instances, estimation of final visual acuity was unreliable, as seen in Table 2.

Case histories with regard to initial and final acuity revealed that:

1. An injured eye with initial vision of 20/200 or better usually resulted in retention of some useful vision.

2. An injured eye with initial vision of less than 20/200 but able to count fingers had a reasonably good chance of retaining useful vision and an excellent chance of being conserved.

Failures in these injured eyes were the result of such complications as intraocular hemorrhage, recurrent or persistent uveitis, cataract, and purulent endophthalmitis. Injured eyes unable to count fingers on admission generally retained little or no vision or had to be removed. The initial acuity of an injured eye, when reliable estimation was possible, offered a good prognostic clue to the final visual result.

TABLE 3

TIME ELAPSED BEFORE TREATMENT*

Final Result	Under 24 hours	Under 48 hours	Over 48 hours
Vision 20/20 20/200	26	6	6
Vision 20/200 Finger counting	10	2	0
Blind eyes	4	1	0
Eyes removed	33	11	8
Unknown	8	0	0
TOTAL	81	20	14

* Approximately one third of injured eyes retained useful vision whether treatment was begun in less than 24 hours, less than 48 hours, or later.

3. INTERVAL BETWEEN INJURY AND HOSPITAL ADMISSION

The relationship between final visual result and the time elapsed before hospitalization and treatment was analyzed in 115 records of the last three years.

4. SITE OF WOUND

Penetrating wounds involving the cornea alone had a slightly better chance of restored useful vision (31.5 percent) than those wounds that involved the limbal region (24.9 percent). Scleral wounds had the worst prognosis for useful vision (18.7 percent). The proportion of globes lost was similarly greater when the wound involved the eye posterior to the limbus. These facts indicate that greater ocular impairment accompanied wounds posterior to the limbus. In many instances the mechanism of injury was found to be a rupture of the globe or laceration produced by a severe blunt force.

5. LENGTH OF WOUND

Wounds are tabulated according to length in millimeters in Table 5. Double perfora-

TABLE 4

SITE OF WOUND

Final Result	Corneal	Scleral	Corneoscleral	Totals
Vision: 20/20 to 20/200	29	13	32	74
Vision: 20/200 to finger counting	8	5	7	20
Blind eyes	16	8	9	23
Eyes removed	38	41	77	156
Unknown	11	4	4	19
TOTAL	92	71	129	292

tions were not included in the series. Wounds less than four mm. in length commonly resulted in an eye that could be saved with useful vision (71.7 percent). When the wound was from four mm. to seven mm. in length, useful vision was retained in 43.5 percent. Wounds eight mm. or more in length for the most part resulted in a blind or lost eye (94.11 percent). Usually, trauma causing the longer wounds was of sufficient force to create severe intraocular injury.

6. TYPE OF INJURY

Instrumental agents recorded on the hospital records were classified into six groups: (a) Glass, such as spectacle lens, bottle and windshield fragments; (b) sharp metal knife, ice pick, nail file, scissors, and fish hook; (c) wooden stick, chip of wood, board, and arrow; (d) metal fountain pen, fan blade, nail, coat hanger, wire, screw driver, iron, tin, bullet, staple, bed spring; (e) blunt objects, such as fist, club, rock, lamp, clock, chair, brass knuckles, fireworks, brick, snowball, auto accident, kick, and explosion; (f) unknown, occurring perhaps during an assault or fall.

Analysis indicates that penetrating wounds inflicted by sharp objects, without great momentum or blunt force, generally had the best prognosis. Perforations by wood seemed to have a particularly bad course. Many were caused by missiles, such as arrows and sticks traveling rapidly and hitting with forceful impact. Endophthalmitis developed in several of such injured eyes. The greatest number of eyes lost resulted from perforations accompanied by force. The mechanics of the trauma produced apparently influenced the prognosis most strongly. Blunt force applied to the globe at the time of the perforation produces two serious consequences:

1. A sudden outward gush of intraocular contents takes place with the prolapse and loss of vitreous and uveal tissue.

2. Derangement of the intraocular structure by transmission of the applied force followed frequently by hemorrhage. Hemorrhage, in itself, extends the injury.

7. INTRAOCULAR TRAUMA ASSOCIATED WITH INJURY

As has been suggested, injury to structures of the globe other than the wound itself was

TABLE 5

LENGTH OF WOUND

Final Result	1–3 mm.	4–7 mm.	8–11 mm.	11 and over mm.	Total
20/20 to 20/200	33	31	4	6	74
20/200 to finger counting	7	4	7	2	20
Blind eyes	0	4	5	14	23
Eyes removed	3	27	29	97	156
Unknown	3	9	5	2	19
TOTAL	46	75	50	121	292

TABLE 6

TYPE OF INJURY

Final Result	Glass	Knife	Wood	Metal	Blunt	Unknown	Total
20/20 to 20/200	39	6	4	10	10	5	74
20/200 to finger counting	5	3	3	3	5	1	20
Blind eyes	3	4	2	2	7	5	23
Eyes removed	20	13	14	20	45	44	156
Unknown	12	1	1	3	1	1	19
TOTAL	79	27	24	38	68	56	292

TABLE 7

ASSOCIATED DISORDERS RELATED TO FINAL VISUAL RESULTS

A. *No associated pathologic findings*

20/20 to 20/200	10
20/200 to Finger counting	0
Blind eyes	0
Eyes lost	0
Unknown	4
TOTAL	14

B. *One associated pathologic finding*

	Iris Prolapse	Lens Injury	Massive Intraocular Hemorrhage	Vitreous Loss
20/20 to 20/200	26	4	2	2
20/200 to finger counting	3	2	1	1
Blind eyes	0	1	0	0
Eyes lost	10	2	17	6
Unknown	13	2	1	2
TOTAL	53	11	21	11

C. *Two associated pathologic findings*

	Iris Prolapse and Lens Injury	Iris Prolapse with Intraocular Hemorrhage	Uveal Prolapse with Vitreous Loss	Vitreous Loss and Hyphema	Lens Injury and Hyphema
20/20 to 20/200	7	13	4	1	2
20/200 to finger counting	3	3	1		
Blind eyes	3	2	2	1	
Eyes lost	9	26	25	4	
Unknown		4	3		1
TOTAL	22	48	35	6	3

D. *Multiple associated pathologic findings*

20/20 to 20/200	5
20/200 to finger counting	3
Blind eyes	4
Eyes lost	52
Unknown	4
TOTAL	68

frequent. Such associated pathologic conditions occurred as prolapse of the iris, injury to the ciliary body, choroid or vitreous, lens injury, and intraocular hemorrhage. One or more of these conditions accompanied most of the injured eyes in the series. The relationship of such findings to final visual result has been tabulated (table 7).

In eyes with a single associated pathologic finding, iris prolapse was the least disturbing, whereas massive intraocular hemorrhage and vitreous loss had the most deleterious effect. When two associated pathologic findings existed, the injured eyes did not fare so well; intraocular hemorrhage and vitreous loss again having been associated with poor results.

Of 68 eyes with three or more associated pathologic findings, only five recovered useful vision, 14 had received a simple laceration of the corneoscleral layer and did not evidence associated disorders; of the 10 that were available for follow-up, all recovered useful vision.

Surgical treatment

Surgical treatment of the eye is recorded as: (1) no repair, (2) direct suture of the wound, (3) direct suture and conjunctival flap, or (4) primary enucleation. Table 8 is an analysis of the surgical procedure employed in consideration of the length of the wound.

Enucleation of 66 eyes was a primary procedure because of the extent and severity of the trauma; 68 eyes were treated conservatively without surgical repair; 158 eyes received primary surgical repair; 56 required a direct suture of the laceration; and 102 required a direct suture and, in addition, a conjunctival flap.

A few eyes did not require surgical repair because the wound was small or because of satisfactory apposition of the wound edges at the time of examination. Useful vision was recovered. In a number of hopeless cases, surgical repair of the eyes could not be attempted and the eyes were later removed. Sixty-six eyes were enucleated or eviscerated as a primary procedure. Comparison of direct suture with or without a flap did not reveal any significant difference in results.

Recommended therapy

A. Surgical

The repair of perforating wounds of the globe should always be regarded as major ocular surgery. The objectives are to repair the wound and restore the normal anatomy and function of the eye:

1. *Preparation.* The patient should be prepared preoperatively with adequate sedation and analgesia. Nembutal, from 1.5 to 3.0 gr., and Demerol, 100 mg., depending on the size of the patient, are routinely employed in adults. General anesthesia is used in children and occasionally in unco-operative adults.

2. *Akinesia and anesthesia.* Thorough investigation of the extent of injury, as well as repair itself, should be deferred until satisfactory akinesia and anesthesia have been accomplished. When general anesthesia is not used, akinesia and anesthesia may be induced by local infiltration and retrobular injection

TABLE 8

Surgical treatment

Length of Laceration	No Repair	Direct Suture	Suture and Flap	Total
1–3 mm.	9	16	21	46
4–7 mm.	21	15	39	75
8–11 mm.	11	15	24	50
11–over mm.	93	10	18	121
Total	134	56	102	292

with a procaine-hyaluronidase-epinephrine solution. If a trained anesthetist is available, pentothal-curare induction along with local anesthesia is entirely satisfactory, for, once its action is established, only a small amount of intravenous anesthesia is required.

3. *Extent of injury.* Evaluation of the extent of injury will be safer and more informative if made under sterile conditions with a quiet, relatively soft eye. Lid retraction is permissible if it is done without pressure on the globe.

4. *Débridement.* Débridement of the wound should be done as always, carefully, and with meticulous removal of any foreign material. This can be accomplished by means of irrigation with a fine stream of saline or penicillin solution from an irrigator tip. A spatula, curette, or sharp-tipped jeweler's forceps, if used judiciously, are helpful in removing embedded particles.

5. *Approximation of wound edges.* Accurate approximation of the wound edges is preferably done by means of direct corneoscleral suturing of the appositional type with a Greishaber needle. The suture material used is 6.0 braided silk. A flap of conjunctiva may be employed if the wound is particularly long, if it has macerated edges, or if it exhibits a tendency to gap. Before final closure of the wound, the anterior chamber may be carefully irrigated to remove any blood or lens material that can be washed out with ease.

6. *Restoration of anterior chamber.* An attempt at restoration of the anterior chamber by the injection of air or saline is usually indicated in order to minimize peripheral anterior synechias and adherent leukoma formation.

7. *Treatment of prolapsed iris.* The method of handling a prolapsed iris will depend on the individual situation and the judgment of the operator. In general, iris tissue that has been exposed an undue length of time had best be excised.

B. Medical

The objectives of medical therapy are the prevention of secondary infection and the control of traumatic inflammatory reaction. Prevention of infection is necessary to preservation of an injured globe.

Massive systemic doses of penicillin preoperatively and postoperatively will produce a satisfactory plasmoid aqueous level; however, subconjunctival injection of penicillin is by far the more effective means of obtaining a satisfactory intraocular level of the antibiotic. Streptomycin may be combined with the penicillin injection.

Owing to its ability to penetrate the blood-aqueous barrier, chloramphenicol, one of the newer forms of prophylaxis and treatment for intraocular infections, is used systemically.

Tetanus antitoxin, or toxoid, should be administered routinely.

Local instillations of chemotherapeutic and antibiotic agents are considered helpful. These may be soluble sulfonamides, chloramphenicol, or other broad-spectrum antibiotics in ointment or solution.

Intraocular inflammatory reaction is minimized when indicated by intravenous typhoid therapy, topical, subconjunctival, or systemic cortisone, hydrocortisone, or systemic ACTH.

Postoperative complications. Because there were so many eyes enucleated as a primary procedure in the group from 1947 to 1951, and because new therapeutic agents were introduced during the last three years, the postoperative complications were tabulated separately for comparison (table 9).

Many of the eyes that were enucleated or eviscerated, as a primary procedure, had cataracts and retinal detachments.

Several of the eyes that were saved exhibited cataracts. These subsequently underwent surgery, with good final visual acuity.

Sympathetic ophthalmia was diagnosed clinically in only one eye in the entire series. On the basis of this study, the incidence of sympathetic ophthalmia appears to be 0.31 percent.

TABLE 9

POSTOPERATIVE COMPLICATIONS

Complications	Group I 1947–1951		Group II 1951–1954	
	73 Eyes Saved	104 Eyes Lost	63 Eyes Saved	52 Eyes Lost
Cataract	19	10	14	4
Glaucoma	2	4	2	1
Retinal detachment	7	14	5	6
Endophthalmitis	1	8	1	6
Sympathetic ophthalmia	0	0	0	1

COMMENT

During the course of this study, certain clinical observations were often seen to be associated with a given result. Although it is obvious that there is no single factor that will serve as a rigid guidepost to the eventual outcome of an injured eye, some trends were clearly recognized:

1. The initial visual acuity of an injured eye on admission to the hospital often suggested the prognosis. The mechanism behind this somewhat surprising parallelism was that eyes with relatively good initial visual acuity were usually free of retinal or lens impairment and of intraocular hemorrhage. The absence of these signs was certainly in favor of a good recovery.

2. Wounds of the cornea were less likely to be associated with severe intraocular injury, and, as substantiated statistically in our study, had a better prognosis.

3. Scleral and limbal wounds were frequently associated with severe lens and retinal damage, vitreous loss, and intraocular hemorrhage. This was especially true when the mechanism of injury was a rupture.

4. The length of the wound was important only because the longer wounds were generally in conjunction with extensive injury to the intraocular structure.

5. The mode of injury was found to be a determining factor: Blunt force produced severe ocular damage. The most serious of all injuries were those caused by rupture of the globe resulting from a blunt force. Those were actually perforations from within, which created a great amount of derangement and loss of ocular content. Associated ocular trauma of all types accompanied the perforating injuries. Only those frequent enough to warrant study were considered. Intraocular hemorrhage and vitreous loss were generally found to predispose to an unsatisfactory outcome.

SUMMARY

Over a seven-year period, 292 patients with

TABLE 10

FINAL VISUAL OUTCOME RESULTING FROM TYPES OF THERAPY

Final Result Eyes Saved	No Repair	Direct Suture	Suture and Flap	Total
20/20–20/200	9	18	47	74
Eyes Saved 20/200 F. C.	4	8	8	20
Final result unknown	5	6	8	19
Eyes removed	109*	16	31	156
Eyes saved but blind	7	8	8	23
TOTAL	134	56	102	292

* Sixty eyes that were removed as a primary procedure are included in this figure.

perforating corneoscleral wounds were hospitalized for treatment. Their hospital and clinic records were analyzed in order to determine which factors might influence the final visual outcome. The most important of these are: visual acuity on admission, length of the wound, site of the wound, mode of injury, intraocular trauma associated with the injury. Postoperative complications were less important; age and sex of the patient do not seem contributory.

Surgical and medical management are discussed with recommended therapy.

Conclusion

With the use of newer drugs and improved surgical techniques, treatment of corneoscleral lacerations should give an optimistic prognosis.

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ON THE APPEARANCE OF FLUORESCENT DYES IN THE AQUEOUS HUMOR AFTER INTRAVENOUS INJECTION*

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In 1882, Ehrlich[1] discovered that fluorescein injected intravenously in rabbits penetrates the blood-aqueous barrier and appears in the anterior chamber within a few minutes. The presence of the dye was indicated by the appearance of a vertical line of green fluorescence situated close to the posterior surface of the cornea. This line remained until the anterior chamber became filled with dyed aqueous. Ehrlich himself considered the line to be the result of two horizontal streams emanating from the sides of the iris and meeting in the middle. This interpretation has, however, been shown to be erroneous.

Schick (1885)[2] showed that Ehrlich's line does not occur if the rabbit is placed with corneal limbus in a horizontal position. Moreover, the model experiments of Türck (1906, 1911)[3,4] make it probable that convection in the anterior chamber is involved. Since the cornea is cooler by about 5°C. than the surface of the iris at room temperature, convection currents arise in the anterior chamber which stream downward from the superior edge of the iris along the posterior surface of the cornea and then upward along the iris.

Fluorescein can enter the aqueous humor from the blood stream both anterior and posterior to the pupil. By using ultraviolet illumination, Fischer (1929)[5] was able to observe the entrance of fluorescein into the anterior chamber from the capillaries of the iris. Since he always found the ciliary epithelium to be colorless on supravital observation, he considered that the dye was not able to permeate into the posterior chamber. However, this view is certainly incorrect. According to Kinsey,[6] one can easily demonstrate the presence of fluorescein in the posterior chamber within a short time subsequent to an intravenous injection by puncturing the posterior chamber.

* From the Department of Pharmacology, University of Uppsala.

Determinations of fluorescein in the aqueous humor have recently assumed importance once more as a result of the use of the dye by Goldmann (1950)[7] in measuring the minute volume of the aqueous humor in humans. In connection with this type of measurement, however, certain assumptions have been made, the validity of which is open to question.

The concentration in the anterior and posterior chambers is involved but neither of the two chambers can be considered to contain a uniform concentration. In addition one is forced to neglect (to a considerable extent) diffusion between the aqueous humor and the vitreous and the lens. In view of these difficulties attempts have recently been made by Linnér and Friedenwald[8-10] and by Becker[11,12] to use fluorescein in an entirely different way in order to obtain a conception of changes in the rate of production of the aqueous humor.

Determinations of appearance time have been performed, namely, the time interval between the intravenous injection of fluorescein and the first appearance of a green cloud in the pupil. The determinations are made with a slitlamp microscope in visible light. The green cloud in the pupil is assumed to be the fluid entering from the posterior chamber. If valid, this method should make possible the study of the rate of production of the aqueous humor under various conditions.

The use of appearance time in the study of changes in the rate of production of aqueous fluid, however, rests on the assumption that it is not the permeation of the dye into the aqueous humor but the convection to the locus of observation which determines the interval between injection and appearance. In order for this to be the case it appears to be necessary that the injected dose be so large that an observable quantity is able to permeate within a period of time which is brief relative to the appearance time. While appearance time should be a function of the dose when small doses are used, the quantity injected should be of no importance when larger doses are used. In addition, large doses of substances with different rates of permeation should yield the same appearance time.

Experiments bearing on these conditions are described in Part I of the present paper. The results indicate that convection is of importance with respect to the appearance of fluorescein in the pupil. These experiments thus support the use of appearance time as a measure of convection. On the other hand, experiments reported in Part II appear to show that during certain conditions of observation the convection factor can be convection in the anterior chamber, which is independent of the rate of aqueous humor production.

Part I

Methods

The following fluorescent substances* have been employed: (1) Sodium fluorescein, (2) sodium oxy-pyrene trisulfonate, (3) sodium di-oxy-pyrene disulfonate.

Ten-percent solutions of these substances were injected intravenously in doses computed in mg./kg. body weight. A group of 14 pigmented male rabbits of approximately two kg. weight was used for the experiments. They were maintained on a diet of oats, hay, and water ad lib. After each experiment an interval of at least one week was allowed to elapse before the rabbits were again used.

The illumination system consisted of a vertical ultraviolet ray apparatus constructed according to Figure 1. The source of light was a mercury lamp (Luma Hg 120 W) enclosed in a bulb of Wood's glass. The light from the lamp was passed through a quartz lens (+13D.), then a narrow slit, two filters (Schott UG1 and BG23 each two mm.), and was finally focused with a convex glass lens of approximately 20D.

The experimental animals were tied into bags before the experiment in order to keep

* The sodium fluorescein was obtained from Kebo Company, Stockholm, sodium oxy-pyrene trisulfonate and sodium di-oxy-pyrene disulfonate from Bayer Leverkusen.

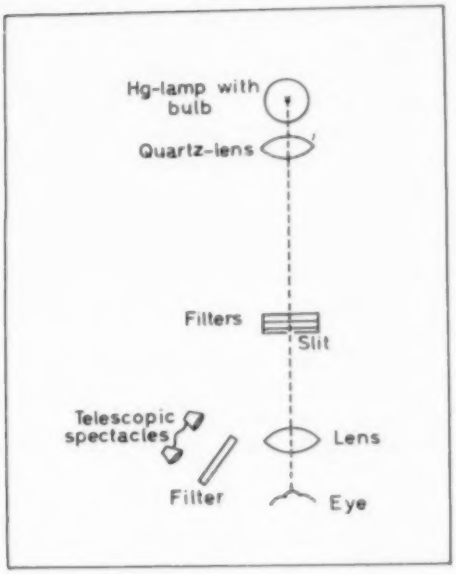

Fig. 1 (Berggren). The illumination system.

them still. The observer had been dark adapted for at least 10 minutes previously. The fluorescent solution was injected into an ear vein, this operation taking 10 to 15 seconds. The rabbit was subsequently placed on its side under the ultraviolet apparatus so that the corneal limbus was horizontal. The appearance of fluorescence anywhere in the anterior chamber was looked for, using telescopic spectacles and a yellow filter (Schott GG8, one mm.). Since the site of the fluorescence could not be accurately observed with this method, the time interval from the moment of injection until the first appearance of a fluorescent Tyndall beam was recorded. This interval could not be measured more closely than 10 to 20 seconds.

Results

The results of the experiments are indicated in Figures 2a, 2b, and 2c. The points have been constructed using a log-log grid, with the time from injection to initial observation of the fluorescent Tyndall beam as the ordinate and the dose in mg./kg. body weight as the abscissa.

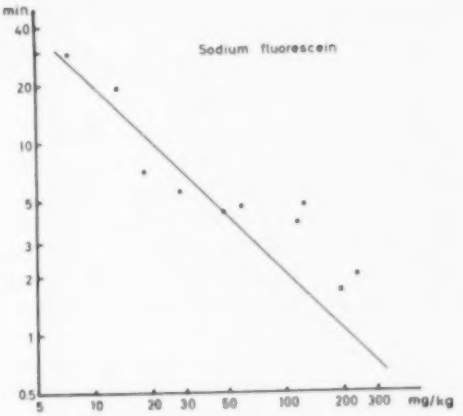

Fig. 2a (Berggren). The results with sodium fluorescein.

If the appearance of the fluorescent substance in the anterior chamber was the result of diffusion alone, the product of appearance time and dose should be constant provided that either complete mixing or no mixing at all occurred in the anterior chamber, and that the time-concentration curves in the plasma water have the same shape independent of the dose, only differing by a constant factor. The relation between log-dose and log-time would then be represented by a straight line at an inclination of 45 degrees.

The figures indicate that this is actually the

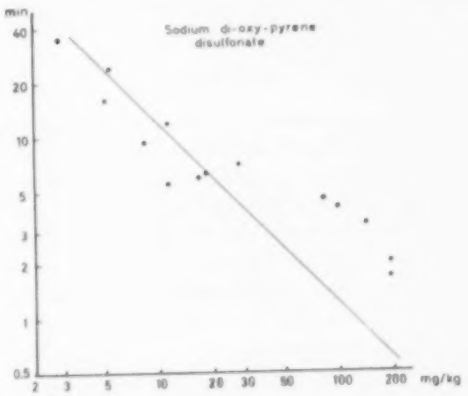

Fig. 2b (Berggren). The results with sodium di-oxy-pyrene disulfonate.

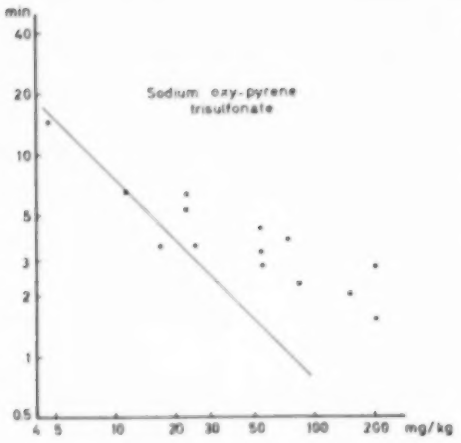

Fig. 2c (Berggren). The results with sodium oxy-pyrene trisulfonate.

case for sodium fluorescein and sodium di-oxy-pyrene disulfonate down to a time limit of approximately five minutes, after which a new factor enters the picture. Here the points deviate from the straight line, the log-times decreasing less rapidly than before with increasing log-dose. This means that a new rate determining factor has begun to play a role. This factor is probably convection in either the posterior or the anterior chamber. This question will be considered further in the following. In the case of sodium oxy-pyrene trisulfonate there are too few points at low dosage to be certain, but at higher doses, the same holds as for the other substances.

Part IIa

The experimental animals were a group of 13 pigmented male rabbits weighing approximately two kg. each. The rabbits had been raised as before but were not the same animals used in the previous experiments. Three animals died during the experiments (two in conjunction with injections and one by accident). At least a week elapsed between each new experiment.

Five-percent solutions of the same fluorescent substances as used previously were employed. (The freezing-point depression for five-percent sodium fluorescein was 0.94°C., for five-percent sodium oxy-pyrene trisulfonate 1.0°C., and for five-percent sodium di-oxy-disulfonate 0.48°C. The solutions were thus not strictly isotonic with the body fluid.) The dose was 100 mg./kg. body weight with an injection time of 10 to 15 seconds into an ear vein. In order to inject the solution as quickly as possible a cannula connected to a syringe by a polyvinyl tube was introduced into the ear vein before beginning the experiment.

The rabbit was placed in a box in front of a corneal microscope and an ultraviolet lamp constructed according to Figure 3. The source of light was a mercury discharge tube (120 W) built into a metal case. A narrow slit in the latter could be moved close to the tube. The light beam passed through two filters (Schott UG1 and BG23, each two mm.) and was subsequently focused by a positive quartz lens (13D).

Using this beam the anterior segments of the eye were observed as usual with a corneal microscope (magnification six to 40 times). After the observer had been dark adapted for at least 10 minutes an assistant injected the fluorescent solution. This enabled the course of events in the anterior chamber to be followed from the instant of injection.

The vessels of the conjunctiva and the nictitating membrane become filled almost instantaneously. After approximately 10 to 20 seconds the vessels of the iris become filled. After about one minute cloudiness

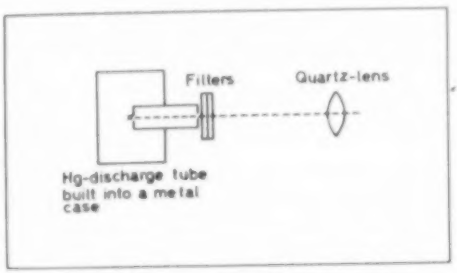

Fig. 3 (Berggren). Construction of the ultraviolet lamp.

around the vessels becomes noticeable, suggesting the occurrence of diffusion. These observations are in agreement with those of Fischer (1929).

Approximately two minutes after injection, a green cloud can be detected at the edge of the pupil (almost always at the lower edge, sometimes at the upper edge, but never from the sides). This time is recorded as appearance time. The beginning of the injection is taken as the initial time. (The initial time of both Linnér and Becker is the moment the conjunctival vessels begin to fluoresce, the difference between the two times can be at most a few seconds.) After an additional period of about 20 to 30 seconds, Ehrlich's line is formed, and finally the whole chamber becomes filled with fluorescent solution.

The appearance times of the three fluorescent substances were rather similar. The mean for sodium fluorescein was 147.1 ± 6.1 seconds; for sodium di-oxy-pyrene disulfonate 152.9 ± 7.2 seconds; and for sodium oxy-pyrene trisulfonate 127.1 ± 10.1 seconds (table 1). Linnér obtained a mean time of 133 seconds for fluorescein. Becker has reported a mean time of 64 seconds, but in none of the above experiments has such a short appearance time been obtained (both Linnér and Becker used nephrectomized animals).

Part IIb

In order to reduce the production of aqueous fluid, both Linnér and Becker carried out experiments with the carbonic anhydrase inhibitor, acetazoleamide (Diamox®), and they obtained a prolongation in appearance time of up to a minute. However, I have not been able to reproduce these results, although a lowering of intraocular pressure was obtained. The same animals were used as in the previous experiments.

The ocular pressure was first measured with a Schiøtz tonometer using the 5.5 gm. weight and topical anesthesia with two-percent Lidocaine. Then Diamox was injected intravenously (50 mg./kg. body weight). Finally, after about 45 minutes, the appearance time of injected fluorescein was determined. Methodology was as before. After this tonometry was performed once again. A mean of 135 ± 9.8 seconds was obtained for appearance time after Diamox, while for the same animals the mean of the earlier experiments had been 144 ± 4.6 seconds (table 1). The reduction in ocular tension was

TABLE 1

APPEARANCE TIMES FOR THE THREE FLUORESCENT SUBSTANCES

Rabbit	Appearance Time (sec.) Fluorescein Na	Appearance Time (sec.) Oxy-pyrene trisulfonate Na	Appearance Time (sec.) Di-oxy-pyrene disulfonate Na	Appearance Time (sec.) Fluorescein Na After Diamox	Tonometer Reading (1 hr. before Diamox) Mean of 3 readings		Tonometer Reading (30–45 min. after Diamox) Mean of 3 readings	
					Right Eye		Left Eye	
22	135	85*	155					
35	145	140	160					
43	165	170	180	125	2.0	2.0	4.83	5.17
50	175	110*	125					
66	140	140	170	150	5.33	5.5	8.33	7.33
68	145			210	1.5	2.0	5.0	6.0
81	140	125	140	90	2.33	2.17	3.33	6.0
91	135			125	2.17	2.67	6.0	6.17
94	150			135	2.83	3.17	5.5	5.33
95	140	120	140	120	3.83	3.83	6.33	8.17
96	170			145	1.67	2.0	6.17	6.33
97	120			120	2.17	2.17	6.67	6.0
99	145			130	2.0	2.33	5.5	6.17
	M = 147.1 ± 6.1 sec.	M = 127.1 ± 10.1 sec.	M = 152.9 ± 7.2 sec.					
	M = 144.0 ± 4.6 sec.			M = 135.0 ± 9.8 sec.	M = 2.63	2.78	M = 5.77	6.07
					2.7		5.92	

* These animals suffered cramps during the injection.

more than three scale divisions as measured with the Schiøtz tonometer.

Part IIc

The Diamox experiments just reported brought up the question whether appearance time is really a measure of the rate of flow of fluid from the posterior chamber or whether convection in the anterior chamber might be involved. Therefore, appearance time measurements were performed once more with the same animals and techniques as used before in this section but this time in a room having a constant temperature of +36°C.

As before an almost instantaneous filling of the vessels of the conjunctiva was observed, followed within 20 to 30 seconds by the filling of the vessels of iris. The subsequent cloudiness around the latter was, however, now considerably more pronounced and a diffuse filling of the anterior chamber occurred. No well-defined cloud appeared in the pupil nor could an Ehrlich's line be seen in any case. The end-point was therefore taken as soon as a definite Tyndall beam could be observed. With this end-point the time was 195.5 ± 14.7 seconds.

After a week the rabbits were retested for appearance time at room temperature. The pupillary cloud could once more be observed after a mean period of 128.5 ± 5.6 seconds (table 2). It is improbable that changes in ocular pressure occurred during these experiments. When a pair of rabbits was tonometrized at room temperature and at +36°C., no difference was detectable.

In order to determine the effect of low temperatures appearance time experiments were performed with rabbits in the cold room at +4°C. These experiments were unsuccessful, however, since condensation phenomena on the lenses of the corneal microscope prevented the observations.

TABLE 2

Experiments in +36°C. room

Rabbit	Visible Tyndall Beam (sec.)	Appearance Time (sec.) Control (After 1 wk.)
35	180	160
43	285	135
68	180	150
81	180	130
91	150	135
94	220	120
95	180	105
96	265	120
97	150	105
99	165	125
	M = 195.5 ± 14.1 sec.	M = 128.5 ± 5.6 sec.

Part IId

Experiments with the same group of rabbits—now, however, tied into bags and placed on their sides with limbus cornea horizontal—were performed, partly to verify Schick's observation that no Ehrlich's line occurs in a horizontal position and partly to see whether appearance time is affected by the altered position. Methods were the same as used throughout in Part II. The marked diffuse filling of the anterior chamber noted in the experiment performed at +36°C. was once again observed. Neither a definite cloud nor an Ehrlich's line could be observed so that here also the time was recorded when a definite fluorescent Tyndall beam became apparent. The time was 198.1 ± 12.6 seconds (table 3).

TABLE 3

Experiments with corneal limbus in a horizontal position

Rabbit	Visible Tyndall Beam (sec.)
43	240
68	230
81	240
91	180
94	180
95	195
97	180
99	140
	M = 198.1 ± 12.6 sec.

Discussion

The results of the experiments performed in the first part of this study indicate that a convection factor probably exists which influences the time of appearance of the fluorescent substances at the locus of observation in the anterior chamber. This is suggested by the deviations from the straight line at approximately the same period for the various substances, independent of the type of substance. So far the experiments thus support the use of appearance time in the study of changes in the rate of formation of the ocular fluid.

The experiments of the second part of the study, however, show that appearance time can be dependent on factors which influence the convection in the anterior chamber, for example the outside temperature, and the position of the globe. At increased outside temperature and when the globe was in a horizontal position the appearance time could not be determined with certainty, since a more diffuse filling of the anterior chamber occurred.

Further, appearance time has been studied following the injection of the carbonic anhydrase inhibitor acetazoleamide (Diamox) in order to determine whether appearance time is influenced by a reduction in the production of ocular fluid. If the appearance time were a measure of the rate of flow of the secreted fluid in the posterior chamber, a prolongation of the time should occur under conditions of reduced production of aqueous humor. However, no prolongation could be observed (in contrast to the results of Linnér and Friedenwald and of Becker).

When slitlamp microscopy is performed with ultraviolet instead of visible light it is possible to follow directly the diffusion process from the iris capillaries. These experiments show that at least under certain circumstances appearance time can be a measure of convection currents in the anterior chamber. That which in visible light appears to be a color-cloud emanating from the pupil can sometimes be seen in ultraviolet light to be a cloud originating from the anterior surface of this iris. This might then correspond to the upward current described by Türck, and Ehrlich's line might be the downward current.

The factors which determine whether that fluorescein which appears first at the point of observation comes from the anterior or the posterior chamber have not been clarified. It is possible that different animal strains differ. If appearance time is to be used as a measure of the rate of production of aqueous humor, the various convection currents must be differentiated so that only convection from the posterior chamber is recorded.

Summary

The appearance in the anterior chamber of three fluorescent dyes (sodium fluorescein, sodium di-oxy-pyrene disulfonate, and sodium oxy-pyrene trisulfonate) after intravenous injection of varying doses has been studied. With low doses, a reciprocal relation exists between dosage and the latency between injection and appearance in the anterior chamber. If the dose is increased so that the latency becomes less than about five minutes, the reciprocal relation is broken, indicating that with high doses convection is the factor determining the rate of appearance. By using ultraviolet slitlamp microscopy under various conditions (varying ambient temperatures, altered position of the bulb, decreased production of the aqueous humor) it has been shown that this convection may be the one taking place in the anterior chamber. The necessity of differentiation between convection in the anterior chamber and posterior chamber is pointed out.

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GALACTOSEMIC CATARACTS

A report of two cases

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Although today the condition known as galactosemia is a well-established clinical entity, with the exception of one[2] and possibly two[1] case reports, the problem was unknown to the medical literature until the classic report of Mason and Turner in 1935.[3] Another case was presented in 1943,[4] but it was not until 1945[5] that mention was first made of the presence of cataracts in association with the typical findings of this condition.

Since that time there has been an increasing number of cases recorded[6–16] so that at present one may find at least 18 recorded instances of the presence of bilateral cataracts in association with galactosemia. Undoubtedly, there have been others, either unreported or undiagnosed, merely because a complete ocular examination was not done, as is the case in the earlier reports. It is interesting to note that cataracts were discovered at a later date[9] in the case originally presented by Mason and Turner.

It is the purpose of this paper to add two more cases to the literature, as well as to record the results of the aqueous aspirations and analyses which were done, these being the first instances of such a procedure in galactosemia.

Case reports

Case 1

On September 14, 1955, B. P., a seven-week-old white girl, was admitted to St. Luke's Hospital with a two-to-three day history of abdominal swelling and lower extremity edema. The child had been seen one week prior to admission at which time she was reportedly doing well except for the

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presence of an inguinal hernia and dermatitis of the buttocks.

The history revealed nothing more except that an older sibling had had a severe illness during the neonatal period at which time a diagnosis of hepatitis was made. A review of the present patient's record showed that she was a breech delivery of seven pounds, two ounces, on July 2, 1955. On August 1, 1955, a note was made that the baby was jaundiced but this was believed to be physiologic. On August 2, 1955, there was a generalized icterus but neither liver nor spleen was palpable. Apparently the problem cleared as the child was sent home at the usual age seemingly in good condition.

Physical examination at the time of this admission revealed a tensely distended abdomen with distended abdominal veins and a demonstrable fluid wave (fig. 1). There was a pitting edema of the lower extremities up to the level of T-10. There were no further physical findings of note except for the presence of bilateral inguinal hernia.

Ocular examination at this time revealed a slight divergence, but funduscopy was not attempted.

On the day following admission an intravenous pyelogram revealed normal functioning and appearing kidneys, and a chest film was also normal. Admission urinalysis revealed the presence of more than two-percent reducing substances. Blood chemistry and routine blood counts at admission were not remarkable except for an elevated white count.

Two days after admission I was asked to see the child and on attempting funduscopy found that any view of the fundus was blocked by what appeared as a large bubble of oil or air situated directly behind the pupil (also since described as typical in appearance of posterior lenticonus).

These findings coupled with the presence of reducing substances in the urine suggested the possibility of galactosemia and a work-up was begun to identify the reducing substance. A liver profile done this same day revealed

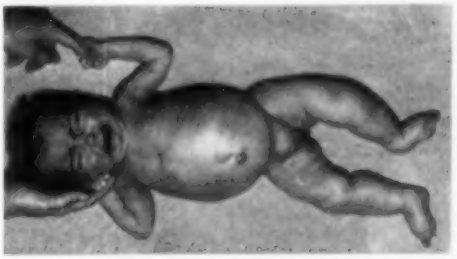

Fig. 1 (Turnbull). Physical appearance of patient in Case 1.

the presence of a good deal of liver damage. Blood cultures, also drawn on this day, were subsequently reported as showing Staphylococcus aureus in one and no growth in the other.

Various qualitative tests were run on the urine for the next two days but all were negative for galactose and indicated that the sugar was glucose.

On September 20, 1955, as the baby was continuing to do poorly, it was put on a lactose-free diet and two days later the fasting blood sugar was 57 mg. and the urine was negative for reducing substances. This same day an aqueous aspiration was done and showed: Reducing substances 123 mg. percent (twice normal); ascorbic acid 1.45 mg. percent (normal).

On September 26, 1955, a glucose tolerance test was done by the micromethod and was normal.

On October 2, 1955, the clinical improvement was apparent on the lactose-free formula. Funduscopy revealed that the cataract of the right eye was almost entirely dispersed and that of the left was much less dense. Fundus details were clearly seen in the right eye for the first time and were normal.

On October 6, 1955, another aqueous aspiration was done and the specimen was run qualitatively for galactose; this was negative. A galactose tolerance test done this day was grossly abnormal.

On October 8, 1955, the ascites and edema were reported as all gone. In an attempt to verify the diagnosis completely the baby was

placed back on the whole milk formula and on October 11, 1955, the galactose was finally identified in the urine.

On October 14, 1955, another liver profile revealed much less evidence of liver damage and on October 16th, the baby was discharged apparently free of edema, ascites, and so forth.

The child has subsequently been seen and continues to do well on a lactose-free diet. The cataracts have almost completely disappeared.

In view of the findings and suspicions through the course of this case, and in view of the history related by the mother that an older child had had a similar problem and even now had visual difficulties, her vision seemingly poorer than another younger sibling, and in view of the hereditary possibilities, it was thought that examination of the other siblings would be helpful, and so on September 27, 1955, the other two children were examined in the eye clinic at St. Luke's Hospital.

At that time C. P., the two and one-half year-old sister, was also found, on funduscopy to have the typical air-bubble appearance of lamellar type cataracts, and slitlamp examination bore this out, although it was noted that they were much less dense than those seen in the baby. The third child showed no evidence of cataracts, nor did the mother's eyes have any abnormal findings.

Case 2

On October 4, 1955, C. P. was admitted to the hospital for study. It is interesting to note that the mother states that his child has independently limited her milk intake, preferring to drink apricot nectar.

A review of this child's past history showed that the child had also been in St. Luke's Hospital at seven weeks of age with hepatosplenomegaly originally believed on an anemic basis. Later a diagnosis of septicemia was made on the basis of a positive blood culture for Staphylococcus aureus. Adrenal insufficiency was suspected and Doca therapy was carried out. There were several instances of suspicion of sugar in the urine and the spinal fluid sugar was elevated, but a glucose tolerance test was normal and nothing more was done on this. A liver profile at the time showed liver damage. Ocular examination was not recorded and apparently was not performed.

Physical examination at the time of this present admission revealed the lenticular changes as previously seen in the clinic. The teeth seemed in a state of poor repair. The abdomen showed excessive venous collateral channels and the liver edge was palpable an inch or so below the left costal margin. The spleen could not be felt. Admission laboratory work revealed normal blood tests, normal blood sugar, and a negative urine.

On October 6, 1955, a galactose tolerance test was done and, as in the younger child, was grossly abnormal. A liver profile showed no evidence of hepatic dysfunction.

Aqueous aspiration was done on this child also but only the qualitative test was performed and this was negative.

A glucose tolerance test was done on October 7, 1955, and was normal and on October 11, 1955, the child was discharged from the hospital.

Discussion

The ease with which this problem may be overlooked unless specifically sought is apparent in these cases, especially the second. The fact that almost all the findings, including the lenticular changes, are reversible if treated early should give an added impetus to early diagnosis and institution of therapy which consists simply in removing lactose from the diet.

The appearance of the cataracts, as described in the case reports, is typical of the lenticular changes seen in 13 of the 18 recorded cases. While this cannot be considered pathognomonic, as it is only the appearance of a lamellar or zonular cataract, it should serve to corroborate the diagnosis in suspected cases.

As to why there was so much difficulty

in identifying the urine reducing substance as galactose, there is at present no answer.

The factors responsible for the pathogenesis of the lenticular opacities in galactosemia are still unproven. It has long been assumed that the basic factor was that of circulating galactose in the aqueous. Bruck and Rapaport[5] found spinal fluid galactose levels close to blood levels and felt that the aqueous must be similar. As to just what is the mechanism of the aqueous galactose in cataract formation is not clear.

Since the discovery many years ago that cataracts could be experimentally produced in rats by galactose feeding, there has been a good deal of work done in attempts to elucidate the mechanism of cataract formation in general and in galactosemia specifically.

Kirby in an extensive study of cataracts in disorders of carbohydrate metabolism[17] showed galactose to be much more toxic to the growth of lens epithelium in vitro than either glucose or levulose.

Bellows,[18] working on the assumption that galactose cataracts in rats were due to interference with the "internal oxidative mechanisms" of the lens, showed that cystine and, to a lesser degree, vitamin C delayed the onset of galactose cataracts. He felt at that time (1936) that galactose caused a loss of sulfhydryl content of the lens, thereby disrupting the functioning of the oxidative systems, and he counteracted this loss by supplying excesses of these sulfhydryls.

Two years later Bellows and Rosner[19] stated that, while they had previously believed galactose to cause a loss of sulfhydryls, they now had experimental evidence to show that the reverse was true, that is, galactose caused retention of glutathione, presumably by decreasing the permeability of the lens capsule. They further confirmed their work later that year.[20]

In 1941, Bellows and Chinn produced lens opacities in rats and dogs by intravenous injections of various crystalloids, causing thereby an osmotic derangement in the blood and thence the aqueous. They also found these changes of hypertonicity to be regressive to some extent.

A similar line of work was presented in 1953 by J. W. Patterson[21] who showed an inverse relationship between severity of hyperglycemia and the time required for cataract development. However, he went further, stating that the cause was a saturation of the enzyme systems involved in cellular absorption and thus by competition preventing the absorption of other essential metabolites. He prevented or delayed development of cataracts by lowering the blood sugar with insulin or phlorizin. In another article in the same year[22] he further presents these views and states that he believes the osmotic or hypertonic effect not paramount, in that there is no correlation between sugar levels and the time of cataract formation. He cites Bellows' work[18] as further evidence of his idea of blockage of cell absorption, in that dietary supplements prevented cataract formation in galactose-fed rats.

As stated, the aqueous analyses reported herein are the first such instances known. The finding of a markedly elevated level of the aqueous reducing substances merely confirms the previously made assumptions that the aqueous galactose levels paralleled those of the other body fluids. To have complete proof of this, a qualitative test should have been performed on the initial specimen. Unfortunately, the value of such a procedure was overlooked until treatment had been started and, by this time, the aqueous had a normal level of reducing substance and was negative for galactose.

It is realized that these first aqueous analyses are of limited value because of the factors described. It is hoped, however, that

Acknowledgment is made to Dr. Earl H. Merz without whose guidance and interest this paper would not have been written. Sincere appreciation must be expressed to Dr. David Shoch and the staff of the clinical laboratory of the Department of Ophthalmology, Northwestern University Medical School, who performed the aqueous analyses.

this report will serve to encourage further and more complete aqueous studies on future cases of galactosemic cataracts.

Summary and Conclusions

1. Two more cases of galactosemic cataracts are presented, together with the results of the first aqueous analyses done in such cases.

2. The possible pathogenic factors of galactose cataracts are reviewed and the application of aqueous analyses to these factors is discussed.

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SURGERY IN OPEN-ANGLE GLAUCOMA

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It is generally agreed that in open-angle glaucoma a completely adequate and careful medical regimen should be followed until definite signs of deterioration of the visual fields occur. By adequate medical treatment, it is understood that all phases of such treatment have been tried to their utmost. One of the reasons for more conservatism in deciding upon surgery in open-angle glaucoma is the unpredictable results that may be obtained.

Surgery is often indicated much earlier in unintelligent patients, particularly those from remote areas who probably would not carry out a strict medical regimen. The younger age group with uncontrolled tension, 40 mm. Hg (Schiøtz) or above, should have the benefit of surgery even before field changes are progressive. Patients with a life expectancy of 20 or 30 years can rarely be controlled on a medical regimen for that length of time. Early surgery has been shown to be more successful than that performed after severe damage has taken place.

The indications for surgery in the older age group with a short life expectancy must be more positive. Patients over 70 years of age, with slowly progressive field losses and elevated tension, may retain central vision for a long time under medical treatment. This is especially true when the disc has a pink healthy rim.

With these few exceptions, the only positive indication for surgical intervention is the progressive loss of field vision despite adequate medical treatment.

Painstaking study of the central area of the field and the blindspots with very small test objects is useful in diagnosis and as a means of predicting the site of subsequent development of gross field defects. But with many patients and in the hands of many perimetrists, these findings are unreliable and not reproducible. Small field defects discovered by such technique are therefore not a practical nor reliable guide in deciding for or against surgical intervention. With a patient under adequate medical treatment and under reasonable control, most surgeons would not advise surgery on the basis of a small field loss discovered by a tiny test object.

Would it not be advisable as a practical matter in the follow-up of glaucoma, to use larger test objects which may be expected to give results more reliably and quickly and which are accurately reproducible?

In many cases, ophthalmologists use an office technician for routine perimetry, and their findings must be reviewed with caution. A technician cannot be a substitute for an ophthalmologist who can see what the optic disc looks like and what the appearance of the disc signifies in regard to the field changes.

The cases often seen in consultation in which the field is contracted down nearly to fixation and the tension is high present a difficult problem. If the vision is good, 20/20 or 20/30, and a slight nasal field is present, even though the field elsewhere is restricted almost to fixation above or below, one need not hesitate to operate if surgery in indicated. But when the nasal field is restricted approximately to fixation and the central vision is reduced by glaucoma alone to 20/50 or less, surgery or medical treatment is probably of no avail and the end-result will probably be loss of central vision. Thus, surgery in these cases is not indicated in spite of uncontrolled tension.

Visual acuity in itself is a poor guide to treatment, and other causes of loss of central vision must be searched for. Fluctuations in visual acuity are common in glaucoma, as are frequent changes in the refractive error. If there are no signs of progress of glaucoma and there is loss of visual acuity, it is probably due to some other factor and should not be the basis for surgical intervention.

Ocular tension is entirely relative, and many patients tolerate a high tension for many years without damage. As Duke-Elder[1] states, "In deciding upon surgery, a limit of tension is difficult to name, for a pathologically high tension for any particular eye is that degree of tension which is doing damage."

Each eye must be considered individually and studied in relation to the damage being sustained. The appearance of the optic disc is most important. A pathologically cupped disc will not tolerate a markedly elevated pressure but, if there are no visible changes in the disc, one can assume that elevated tension is being well tolerated. Obviously, one must watch for these changes with care and at frequent intervals.

The study of the lens is most important. The presence of lenticular opacities is a frequent finding in glaucoma patients in the older age group. It is well known that these opacities, and more especially cortical opacities, progress more rapidly after glaucoma surgery. If lenticular opacities seriously interfere with vision in the presence of open-angle glaucoma and the tension is controlled by miotics, the cataract should be extracted. This may even be true with incipient posterior polar or nuclear cataracts in the presence of miosis. These extractions should be performed with a complete iridectomy, tearing out the root of the iris at the base.

When tension is uncontrolled by an adequate medical regimen, and the opacities obscure central vision, the glaucoma should have the benefit of surgery first. The site of the operative procedure can be well over to the nasal side to allow ample room temporally for a lens extraction later. If iridencleisis has

been selected as the operation of choice, the nasal pillar should be used, leaving the temporal portion of the iris as free as possible for the subsequent lens extraction.

If the glaucoma is very far advanced, one is more hesitant in advising cataract surgery as these eyes respond poorly to surgery, and the amount of improvement in vision is difficult to predict.

In general, then, one must decide whether or not surgery is necessary to preserve this particular patient's vision. In contrast to the narrow-angle type of glaucoma, preventive surgery is never indicated.

The important considerations are:

1. Deterioration of the field of vision and its present status.
2. The level of base tension.
3. The narrowness of the angle.
4. The condition of the lens.
5. The age of the patient and the senile changes involved.

Choice of the Surgical Procedure

Once the decision is made that surgery is indicated in a case of open-angle glaucoma, the next important consideration is the choice of operative procedure.

Iridencleisis

Iridencleisis is being increasingly used and is most valuable in:

1. Those cases in which a moderate reduction in tension is desired.
2. Open-angle glaucoma in which the angle has become narrowed.
3. The aged when the conjunctiva is thin and friable, and a trephining operation is likely to result in a thin cystoid scar and profound hypotony.

It should be used early for, if the glaucoma is far advanced and the tension is high (over 45 mm. Hg), there is less chance of success. The principal drawback is the fear of sympathetic ophthalmia, and even this slight hazard will undoubtedly be reduced with modern use of the cortisone group of medication.

There are many different techniques reported. One or two pillars of the iris can be incarcerated, or an oblique iridotomy preserving the sphincter and drawing the tongue of the iris up into the wound (iridotasis) may be performed. One of the popular incisions is Stallard's[2] scleral flap, which gives a hinged effect to prevent early closure. Dunnington[3] advocates a vertical incision through the sclera, as the wound closes less easily with this type of incision.

Postoperative massage should never be done in the presence of fresh blood in the anterior chamber. Massage, if done, should begin at the end of 24 hours or not until the fifth day, and only if the anterior chamber is well formed.

Cataract Extraction Combined with Iridencleisis

This procedure as a one-stage operation in selected cases has been advocated by a few surgeons. In my opinion it should never be accepted as a logical and safe procedure. The added danger and trauma involved far outweigh the slight advantage of avoiding a second operation. It is suggested that many of the successful results reported were angle-closure glaucomas in which filtration was not necessary. In such cases, this procedure would only add to the danger of complications.

Trephination

The trephining operation is still a most valuable procedure. It is indicated in advanced open-angle glaucoma in the younger and presenile age groups in which the base tension is greatly elevated, or in any age group with high tension and normal conjunctiva. It is less desirable in the older age group with thin friable conjunctiva, and in cases of open-angle glaucoma in which the angles are narrow.

A few points of technique are worthy of repetition.

1. It is well to make a slanting incision in the cornea with a small knife, such as the Wheeler knife needle, and through the in-

cision inject saline to deepen the anterior chamber before the trephine is used. This protects the lens by pushing it back and also restores normal pressure that may have been reduced by the retrobulbar injection. This increased pressure makes it easier to cut with the trephine blade.

2. Although I have used mechanical trephines in the past, it is felt that a very sharp hand trephine gives better and more delicate control of the incision.

3. In selecting the site of operation, one must avoid areas of scarring from previous surgery in both the conjunctiva and the angle.

4. It is important to close Tenon's capsule. A good method is to close it separately with buried gut sutures. If not closed, the cut edge may extend down and block the filtration area.

5. If done in the presence of iris atrophy, the iris should be slowly pulled out and a complete iridectomy performed.

6. A method described by Verhoeff and Chandler[4] has great appeal. In this technique, the conjunctiva is grasped above the limbus (about four to six millimeters) and is drawn down over the cornea. Then the incision is made directly over the limbus, exposing just enough sclera to carry out the trephine technique. In this way, the scarring of a large subconjunctival area is avoided.

Sclerotomy

Sclerotomy alone is less often used today, as it is more difficult to judge the size of the portion of the sclera to be excised. In its favor is the fact that cystoid scars are less frequent. It is more often used when combined with iridencleisis in cases with high tension.

Cyclodialysis

Cyclodialysis has many advocates in open-angle glaucoma with moderately elevated tension, and in aphakia. In New England, most surgeons use this procedure only in selected cases with aphakia. It is a relatively safe procedure and can be repeated. The frequent necessity of repeated operation and the occasional danger of severe hemorrhage have caused many surgeons to give it up as a routine primary procedure, especially since iridencleisis is equally safe and more positive results are obtained.

There are many modifications of the original operation. In order to lessen the danger of bleeding, O'Brien[5] advocated repeated forward thrusts of the spatula instead of wide sweeps. One objection to this method is found by the postoperative examination with the gonioscope; namely, a few strands of adhesion are found remaining in the cleft which may tend to close the area more quickly. Allen[6] makes an incision at right angles to the limbus with one end of the incision at the limbus. He then separates the scleral spur on either side. He feels that this method is less likely to injure the long ciliary nerves and vessels.

Cyclodiathermy

Cyclodiathermy, both surface and partially penetrating, has recently been enthusiastically reported by a few ophthalmologists. Some have even claimed excellent results in all types of glaucoma. The recent tendency has been to move the area of diathermy back six to eight mm. from the limbus.

In my opinion, cyclodiathermy in wide-angle glaucoma should be used only as a last resort, and even then with considerable trepidation. Six cases of postoperative separation of the retina have been observed at the Massachusetts Eye and Ear Infirmary following this procedure. Bodian[7] has reported two cases of sympathetic ophthalmia. McLean,[8] after several years of experience with this procedure, reports unsatisfactory results. More positive evidence of any advantages and safety will have to be provided before this operation should be advised as a routine procedure in open-angle glaucoma.

Cycloelectrolysis

This procedure has the same indications as

cyclodiathermy, but some authors claim this method has fewer complications.

Retrobulbar injection of alcohol.

Retrobulbar injection of alcohol can be used in blind, painful eyes with absolute glaucoma. In such cases, it is the only substitute for enucleation, as other procedures may produce sympathetic disease.

Causes of failure

Although this subject is too comprehensive to review in detail, there are a few points that can be stressed.

I was greatly impressed many years ago by Chandler's[9] so-called "pessimistic" selection of the site of an operative procedure. If not contraindicated by the prevailing conditions, he advised operating well to one side of the midline of the upper limbus, thus allowing a virgin area for further surgery if it is indicated later.

Surgical failures in general are due to:

1. *Faulty choice* of the surgical procedure.

2. *Faulty technique.* It might be well to mention that this fault applies not only to the surgery of the deep wound, but also to undue trauma in making a conjunctival flap. A surgeon who is meticulous about his intraocular technique can nullify the effectiveness of the procedure by careless and hasty preparation of the flap. This will result in traumatic injury to the filtration bed. Bleeding under the flap promotes scarring, and coagulation must be used sparingly, if at all, as this in itself may produce more scar formation.

3. *Malplaced incisions.*

4. *Hemorrhage during or after surgery.* Bleeding into the anterior chamber if in small amounts does not clot, and will do no harm. Large amounts do cause damage and may plug the filtration angle.

5. *Uveitis.* The eye must be watched with great care postoperatively, as there is a great variation in the degree of reaction in glaucoma operations. Treatment will vary with each individual case, but treatment must be started immediately if iritis develops.

6. *Failure of the anterior chamber to form.* A persistent flat chamber is a serious complication, and may superimpose the hazards of angle closure on what was primarily open-angle glaucoma. If a leak in the wound can be demonstrated by fluorescein, it should be touched with the actual cautery. If choroidal detachment is present and the flat chamber persists, the subchoroidal fluid should be drained and air injected into the anterior chamber. With a flat chamber with no choroidal detachment and no evidence of wound leakage, air injection into the anterior chamber will usually correct the situation.

7. *Lastly,* there are those cases which, in spite of apparent adequate and proper surgery, do develop a reoccurrence of high tension. These cases demand a careful reevaluation and study, and we can be grateful if we have chosen the "pessimistic" area for the first operation.

Summary

To summarize briefly, the indications for surgery in open-angle glaucoma are the failure of an adequate medical regimen and progressive loss of field vision. Even more positive indications may be necessary in the old age group with short life expectancy. Uncontrolled elevated tension in the younger age group may indicate early surgery, even before progressive field loss is evident.

The choice of the operative procedure varies with the clinical findings and the age of the patient, and also with the experience of the surgeon. He should select the type of surgery that works best in his hands.

In my experience, there still has been no completely satisfactory substitute for iridencleisis and the trephining operation in true open-angle glaucoma. Iridencleisis is valuable when a moderate reduction in tension is desired or when the angle has become narrowed and also in the older age group with marked

senile changes. The trephining operation, performed by some method that reduces trauma to a minimum, is indicated in advanced glaucoma in the lower age group in which the tension is highly elevated.

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BRAIDED WHITE NYLON SUTURES*

For muscle operations, scleral resections, evisceration, and plastic surgery†

Conrad Berens, M.D., George Z. Carter, M.D., and
Arnold S. Breakey, M.D.
New York

Nylon monofilament sutures have been used surgically for over 10 years after studying reactions in the eyes of rabbits.[1] From the standpoint of tissue reaction and tensile strength this material has proven more satisfactory than catgut (chromic or plain), silk or cotton. The main objection to the monofilament suture was that it was excessively stiff which made it difficult to manipulate and knot. On several occasions it protruded through the conjunctiva after lateral rectus surgery.

These difficulties have been largely overcome by the manufacture of braided white nylon (5-0) sutures which have proven to be extremely pliable and as easy to manipulate as cotton. They are double-armed with two number 384 5-0 curved cutting needles and are supplied in 10-inch lengths. Braided nylon sutures have been used in over 120 eyes during the past 18 months with unusually mild reaction and no infection. In lateral rectus surgery the tendency to perforate the conjunctiva is eliminated completely by passing the suture ends through the rectus muscle.

Retroplacement of the rectus muscles

The technique used in retroplacement[2] of the rectus muscles is:

The eye is forcibly rotated in the direction opposite to the action of the muscle to be operated upon, by a traction suture inserted at the limbus. The tendon is exposed by means of a curvilinear incision parallel to the semilunar fold nasally and over the insertion of the lateral, superior, and inferior recti. Tenon's capsule is seized above the superior border of the tendon and is buttonholed.

A strabismus hook or blade of a special muscle forceps[3] is passed under the tendon and the tip is exposed by means of a counter-button hole opening at the other side of the muscle. The forceps is closed when the jaws are in firm contact with the scleral insertion

* From the Department of Ophthalmology, New York University Postgraduate Medical School. Aided by a grant from The Ophthalmological Foundation, Inc., and the Department of Research of the New York Association for the Blind.

† Made by Davis and Geck, Danbury, Connecticut.

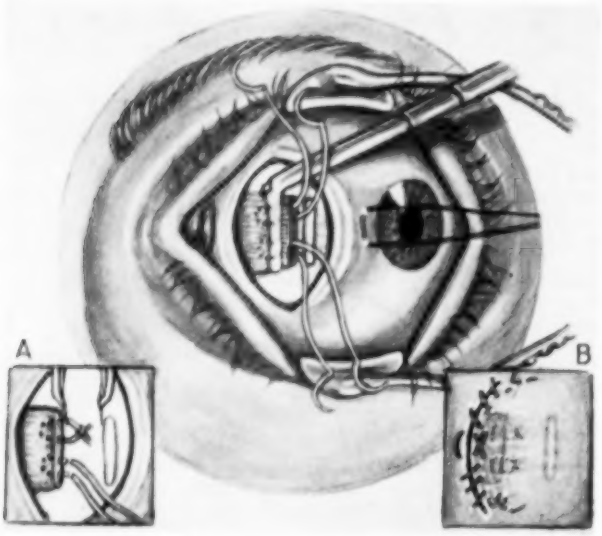


Fig. 1 (Berens, Carter, and Breakey). *Retroplacement of the medial rectus.* After the muscle is exposed and grasped with a special muscle forceps, and freed from its insertion, two double-armed white braided nylon sutures are looped on the posterior surface of the muscle and passed through the perforations in the jaws of the forceps. (A) The amount of displacement of the muscle is measured and marked with marking calipers and the sutures passed through the episcleral tissue at the points marked. (B) The conjunctiva is closed with catgut.

of the tendon and the muscle is then freed from its insertion with scissors.

Two double-armed white braided nylon sutures (5-0)are inserted through the muscle and Tenon's capsule from the scleral surface and then through the perforations provided in the jaws of the muscle forceps, leaving a loop on the posterior surface of the muscle (fig. 1).

Tenons' capsule is freed sufficiently to permit the desired amount of displacement of the insertion which is measured and marked on the sclera with the points of a grooved caliper[4] after dipping the points in a one percent solution of methylene blue. The muscle is freed completely from the underlying sclera, the overlying conjunctiva, and tissue under the caruncle so that the muscle can assume its new position without traction on other tissues, which may result in postoperative sinking of the caruncle.

The four needles independently engage the episclera for two mm. at the four points marked (fig. 1-A), and are securely tied after release of the traction suture.

The conjunctiva is closed with a 5-0 centrally tied running catgut suture, the ends of which are locked (fig. 1-B).

Resection of the rectus muscles

The tendon covered by Tenon's capsule is exposed as in the retroplacement operation. The tendon is stretched between two muscle forceps, one passed at the insertion and the second locked at the distance from the insertion equal to the resection desired (fig. 2). Tenotomy hooks may be substituted for the muscle forceps and care should be exercised to ascertain that all the tendinous fibers are included on the hook. Two double-armed 5-0 white braided nylon sutures are inserted two mm. posterior to the forceps, through the muscle and Tenon's capsule from the scleral surface of the muscle, and passed through grooves in the muscle forceps. The muscle is cut close to the scleral insertion, leaving a short stump, and the excess of muscle tissue is excised within one mm. of the blades of the forceps. The four needles are passed through the muscle stump and are tied firmly, drawing the muscle into close apposition with the scleral stump (fig. 2-A). The conjunctival wound is closed with a centrally tied 5-0 running catgut suture.

Retroplacement of the inferior oblique[5]

An elliptical incision (concavity down-

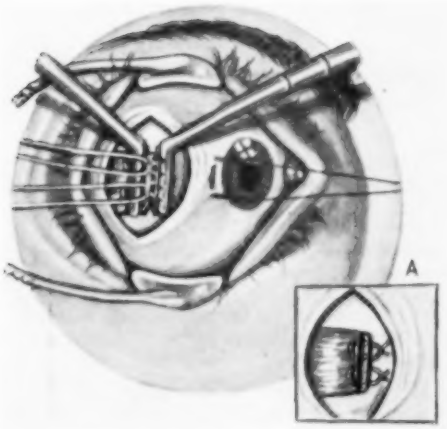


Fig. 2 (Berens, Carter, and Breakey). *Resection of the rectus muscles.* The muscle is gently stretched between two muscle forceps, one at the insertion and the second at the distance from the insertion equal to the resection desired. Two double-armed white braided nylon sutures are inserted from the scleral surface. The muscle is cut close to its scleral insertion, leaving a short stump, and the excess of muscle tissue is excised within one mm. of the blades of the forceps. (A) The four needles are passed through the muscle stump and firmly tied.

ward) is made in the conjunctiva approximately 10 mm. from the limbus in the lower temporal quadrant of the eye. A piece of Tenon's capsule is excised, and by forcibly rotating the eyeball nasally and upward with a bipronged scleral hook,[6] and by retracting the conjunctiva and Tenon's capsule with an illuminated plastic retractor,[7] the insertion of the inferior oblique can usually be seen at the lower border of the lateral rectus. The inferior oblique muscle and Tenon's capsule are grasped with fixation forceps at the insertion and carefully separated from the overlying lateral rectus muscle. Care should be exercised not to injure the inferior temporal vortex vein.

A blunt Stevens scissors is used partially to serve the tendon close to its insertion. Temporarily severing the attachment of the lateral rectus simplifies the operation, but is not necessary unless the lateral rectus is to be resected or recessed. A double-armed braided white or blue nylon suture with a special curved needle[5] is inserted through the freed end of the inferior oblique muscle (fig. 3-A), and the muscle is completely freed from its attachment. A second double-armed suture is inserted through the cut edge posteriorly. The muscle is recessed a predetermined number of millimeters, measured with calipers.

The sutures are introduced into the episcleral tissue only and are tied with a surgeon's knot (fig. 3). The posterior sutures should be placed nearer the original insertion to keep the new insertion parallel to it. Retroplacement of one mm. usually corrects approximately one diopter of hypertropia in the primary position and two diopters in the field of action of the inferior oblique.[6] The conjunctival wound is closed with a centrally tied running 5-0 plain catgut suture.

Lamellar scleral resection

A winged eyelid speculum[8] is used to prevent pressure on the globe or eyelid sutures may be required. A lateral canthotomy may be performed to obtain the widest possible palpebral fissure. The conjunctiva and Tenon's capsule are incised and thoroughly undermined over the area of the retinal detachment. Depending upon the amount of scleral resection required, one or two rectus muscles may have to be tenotomized. Two double-armed braided 5-0 nylon sutures are inserted in the muscle, and the muscle is then reflected. A bipronged scleral hook or a traction suture is placed in the muscle stump and the eyeball rotated temporally for a medially placed resection.

The scleral resections (from two to three mm. in width have been found to be more successful than wide resections, and the length should include not less than one third

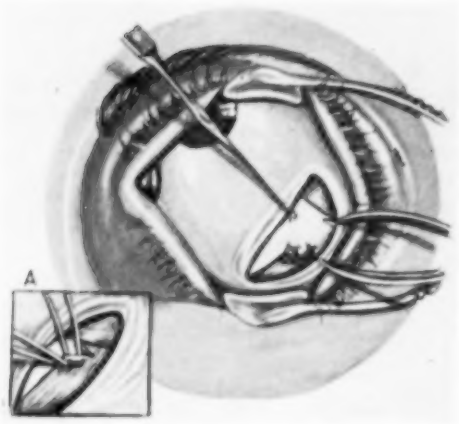


Fig. 3 (Berens, Carter, and Breakey). *Retroplacement of the inferior oblique.* The eyeball is forcibly rotated upward and nasally. A piece of Tenon's capsule is excised and the insertion of the inferior oblique isolated from the overlying lateral rectus muscle. (A) Blunt Stevens scissors is used to sever partially the tendon close to its insertion and a double-armed white braided nylon or special blue monofilament nylon suture is inserted through the cut edge posteriorly. The muscle is receded a predetermined number of millimeters, measured with calipers after inserting a second double-armed suture. The needles are inserted into the episcleral tissue, placing the posterior sutures nearer the insertion, and tied.

the circumference of the globe) should be centered over or slightly behind the retinal tear. The proposed crescent-shaped resection is outlined by applying a cautery to the exposed sclera; the anterior edge is usually two to six mm. behind the muscle insertion and approximately 10 mm. from the corneal limbus. In cases where the resection is performed nearer the equator, care must be exercised to avoid injuring the vortex veins. A bipronged hook or traction suture is inserted through half the thickness of the sclera at one edge of the proposed resection. A ground-down sharp Graefe or Lundsgaard knife is used to outline the strip, penetrating approximately one third to two thirds of the scleral thickness. Profuse bleeding may necessitate the use of the Hildreth cautery. Caution must be exercised, if the bleeders prove to be vortex veins, to avoid intraocular hemorrhage.

Having outlined the scleral incision to the proper depth, which leaves only a few fibers, the strip is carefully dissected using a Paufique corneal knife to start the incision and a Desmarres or new round lamellar keratectomy knife* to complete the dissection. Double-armed 5-0 braided nylon mattress

* Storz Instrument Co., Saint Louis, Missouri.

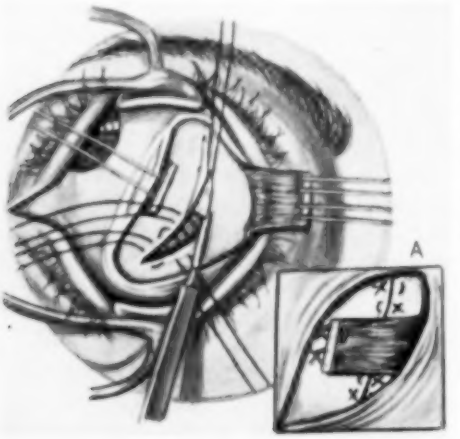


Fig. 4 (Berens, Carter, and Breakey). *Lamellar scleral resection.* The conjunctiva and Tenon's capsule are incised and thoroughly undermined over the area of the retinal detachment. Two double-armed white braided nylon sutures are inserted in any muscle requiring severing (except the lateral rectus where mild chromic catgut is used). The proposed crescent-shaped scleral resection is outlined and dissected. Double-armed 5-0 braided nylon mattress sutures are inserted for every two to three mm. of resection. The alternate sutures are apposed so that counter-traction may be exerted when the sutures are tied. (A) The severed rectus muscle is resutured to its insertion.

sutures are inserted through both lips of the wound three mm. apart. The alternate sutures are opposed so that counter-traction may be exerted when the sutures are being tied (fig. 4). A V-shaped or chevron incision has been used recently but it is too early to determine whether it will be more successful than the elliptical incision. The remaining sclera and underlying choroid is touched along its entire length with a cotton-wound applicator dipped in three-percent potassium hydroxide (some prefer surface diathermy). The intraocular pressure is reduced and the subretinal fluid is drained by applying a catholysis needle puncture or punctures with a current of two ma. through the site of resection over the area of the detached retina. Care should be used, in any region where the choroid may be completely exposed, to prevent vitreous loss.

The scleral sutures are tied and the severed rectus muscle is resutured to its insertion (fig. 4-A). Tenon's capsule and the conjunctiva are closed with a running 5-0 plain catgut centrally tied suture. If the retina does not seem to be in place after operation, it is usually desirable to inject air into the vitreous. The canthotomy wound is closed with one or two 5-0 braided white nylon mattress sutures.

Evisceration using the Rosa-Berens hollow plastic intrascleral implant[9]

A circumcorneal conjunctival incision is made one mm. from the limbus and the conjunctiva is undermined to the insertion of the rectus muscle. A sclerocorneal section is made with a narrow cataract or curved glaucoma knife, and the cornea is excised with curved scissors (fig. 5). Triangular areas are excised from the sclera at the horizontal extremities of the wound (indicated by dotted lines, fig. 5). Transforming the circle into an elongated wound insures a firm closure without buckling of the sclera.

The contents of the scleral envelope are carefully removed with an evisceration spoon. Additional curetting is performed at the optic disc to bring it to the same level as the surrounding sclera, to prevent secondary irritation at the nerve by the implant. The entire inner surface is examined with an illuminated retractor to see if any of the choroid is still adherent to the sclera, which is thoroughly curetted with a spoon.

From five to seven mattress sutures (5-0 braided white nylon) are inserted through the edges of the scleral lips (fig. 5-A), and a hollow plastic Rosa-Berens implant* is inserted with the spherical surface posterior and the flattened anterior surface anterior.

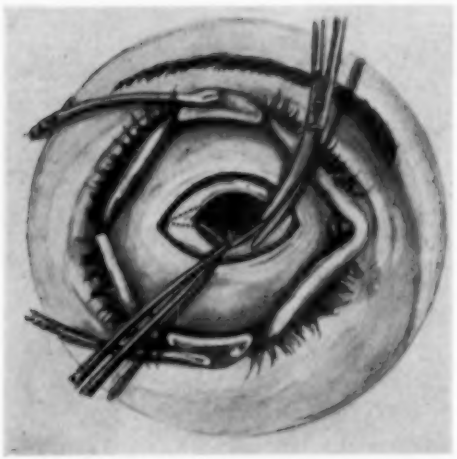
Care should be taken that the elongated flat surface is horizontal. The correct position of the implant may be assured by placing a double-armed nylon suture through the suture tunnels in the end of the flattened anterior surface, then passing the needles through the sclera in the horizontal meridian and tying them securely on the external surface of the sclera. The implants* are now being made with a mesh cap on the anterior surface to assure firm adhesion between the tissue and the mesh. The scleral sutures are firmly tied and the conjunctival wound is sutured with a running centrally tied 5-0 catgut suture (fig. 5-B).

Resection and advancement of the levator for ptosis

The proposed incision to form the palpebral fold is outlined in gentian violet along a skin fold and the incision is made with a Bard-Parker knife. The superior skin and orbicularis flap are undermined with blunt scissors. The upper eyelid is doubly everted and the conjunctiva ballooned with saline solution to facilitate dissection. A buttonhole incision is made in the conjunctiva which is carefully undermined with blunt scissors (fig. 6-A). The conjunctival incision is closed with plain catput.

The eyelid is made to assume its normal position and the lower blade of a special ptosis forceps[10] is inserted under the levator

* Made by R. O. Gulden, Philadelphia 20, Pennsylvania.



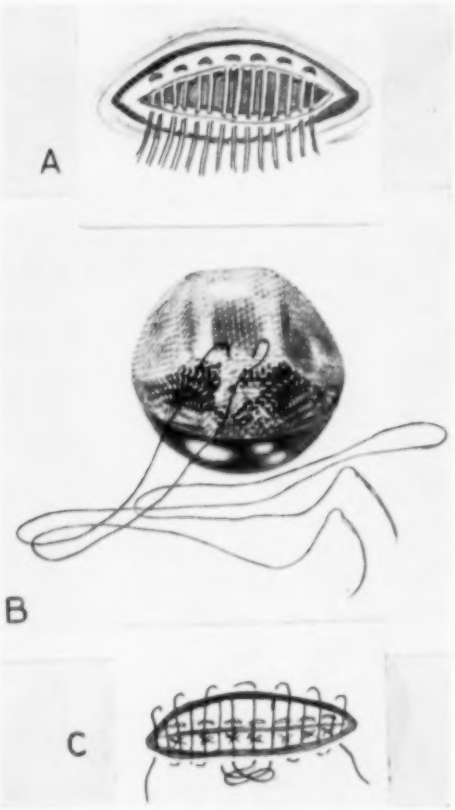


Fig. 5 (Berens, Carter, and Breakey). *Evisceration using the Rosa-Berens hollow plastic implant.* A circumcorneal conjunctival incision is made one mm. from the limbus and the conjunctiva undermined to the insertion of the rectus muscles. The cornea and one mm. of the sclera are excised after making a cataract section in the sclera. Triangular areas are excised from the sclera at the horizontal extremities of the wound. (A) After evacuating the contents of the scleral envelope, from five to seven mattress sutures (double-armed 5-0 braided white nylon) are inserted through the edges of the scleral lips. (B) The implant (showing one preplaced nylon suture) is inserted, scleral sutures tied, and the conjunctival wound united with a running centrally locked catgut suture (C).

which is severed at the upper tarsal border. The levator is isolated as far as desired with blunt scissors. Another ptosis forceps is applied at the required distance measured with grooved calipers[4] above the first forceps, and the levator is severed close to the second forceps.

Three double-armed white braided nylon sutures are looped on the posterior surface of the levator and passed through the holes in the forceps. The levator is advanced and anchored to the tarsus (fig. 6). Silk skin sutures are passed deep through the lower skin incision then through the deep tissues under the upper flap emerging three mm. from the wound border. The needle is reversed, passed through the upper and lower wound edges, and tied (fig. 6-B). A double-armed 5-0 nylon suture, threaded through a plastic strip, is passed through the skin three mm. below the lower eyelid border, emerging in the gray line. The lower eyelid is drawn upward and anchored above the eyebrow by adhesive strips.

Correction of entropion by canthotomy and canthoplasty (Berens modified Poulard operation)

An eight-mm. lateral canthotomy is performed. A fixation forceps is placed on the lower eyelid, close to the canthotomy wound, and the lower eyelid is pulled forward. The points of the Stevens scissors are introduced in the wound. By using the scissors as a probe, the fibrous bands forming the expansions of the lateral canthal ligament may

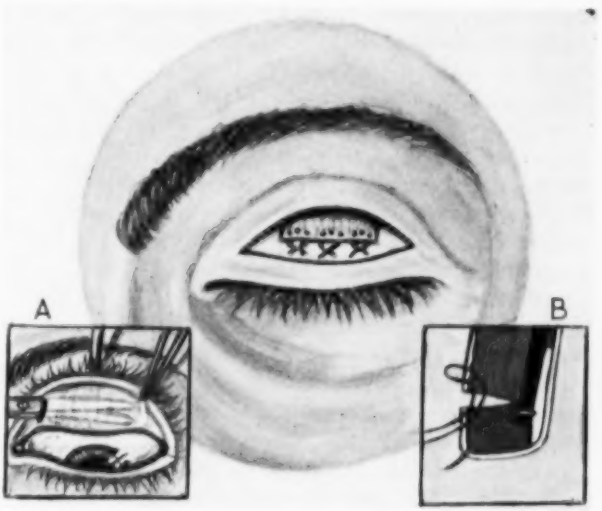


Fig. 6 (Berens, Carter, and Breakey). *Resection and advancement of the levator for ptosis.* Following the skin incision in the upper eyelid and undermining of the superior skin and orbicularis flap, the eyelid is doubly everted and the conjunctiva is ballooned to facilitate careful undermining of the conjunctiva. (A) A special levator forceps is applied to the muscle at the upper tarsal border, the levator is severed from the tarsus, freed as far as necessary, and another forceps is applied at the point where the muscle is to be resected. Three double-armed braided white nylon sutures are inserted through the levator above the clamp and then through the holes in the forceps. The levator is advanced the distance desired and anchored to the tarsus. (B) Silk skin sutures are passed deep through the lower skin incision then through the deep tissues under the upper flap emerging three mm. from the wound border. The needle is reversed, passed through the upper and lower wound edges, and tied.

be identified. These expansions are divided completely in both the lower and upper eyelids (fig. 7).

The edge of the lower eyelid margin, posterior to the line of cilia, is excised medially to the canthotomy wound for from three to five mm. (fig. 7-A). A similar freshening of the anterior portion of the upper eyelid may be made two mm. in length.

One of the needles of a 5-0 braided white

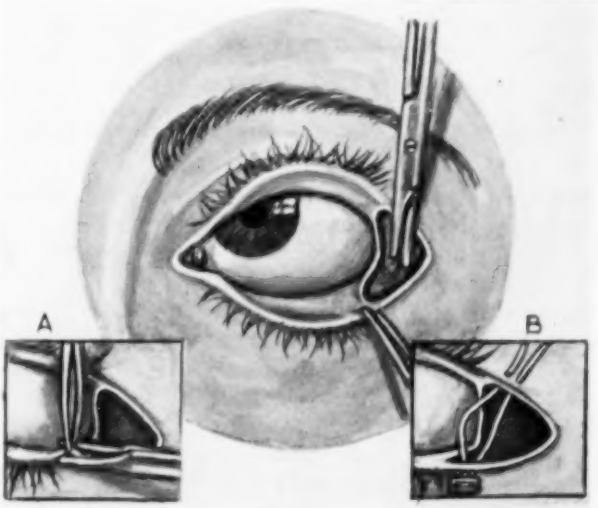


Fig. 7 (Berens, Carter, and Breakey). *Correction of ectropion by canthotomy and cantholplasty.* An eight mm. lateral canthotomy is performed and the fibrous expansion bands in the lower and upper eyelids are divided. (A) A three to five mm. excision of the edge of the lower eyelid margin is made medial to the canthotomy wound, and two mm. of skin excised from the upper eyelid margin. (B) A double-armed 5-0 braided white nylon suture threaded through a plastic strip is passed through the skin of the lower eyelid below the edge of the freshened marginal area, brought up through the upper eyelid, and tied. An additional double-armed suture is placed laterally.

nylon suture is passed through a plastic strip and is introduced in the skin, approximately five mm. below the edge of the freshened marginal area of the lower eyelid, and emerges from the medial extremities of this area. The needle is carried to the corresponding area of the upper eyelid and emerges through the skin five mm. above the wound (fig. 7-B). The second needle of the same suture is introduced three mm. further temporally in a similar manner, and the two ends of the suture are tied over a plastic strip. An additional double-armed nylon mattress suture may be introduced more laterally, or the wound may be united with interrupted silk sutures.

The 5-0 braided white nylon sutures also have been utilized satsifactorily in the closure of corneal lacerations, skin lacerations, and plastic surgery of the eyelids.

Summary

Braided white nylon (5-0) sutures have been used for a period of 18 months in all extraocular muscle operations, in lamellar scleral resections, in eviscerations of the eyeball, in resection and advancement of the levator, and in surgery for spastic entropion. These surgical techniques and the use of the braided nylon sutures have been described.

Braided nylon sutures have been equally satsifactory in the closure of some corneal lacerations, skin lacerations, and plastic surgery of the eyelids.

Braided white nylon sutures are manipulated as easily as cotton, tie with great ease, pass through tissue more readily, and produce unusually mild reaction.

708 Park Avenue (21).

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THE SURGICAL TREATMENT OF DIVERGENCE-EXCESS TYPES OF INTERMITTENT EXOTROPIA*

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In 1952, in an evaluation of surgical results in horizontal[1] concomitant strabismus, the danger of esotropia following recessions of the external recti in certain cases of intermittent exotropia was pointed out. Two cases were described. At that time and subsequently,[2] it was suggested that recession of one or both medial rectus muscles be included in those cases in which only a deviation for distance was present or where the deviation for distance was markedly greater than for near. Since that time there has been opportunity to carry out this procedure in three cases. The successful results prompted this report. No previous report of recessions of the internal recti in cases of more or less "pure" divergence excess has come to my attention.

The two cases of divergence excess which were followed by an esotropia for near following recession of both lateral rectus muscles follow. One of these patients (C. L.) is the same on whom a second operation was done, which is described in this paper.

Case 1. S. C., aged six years, intermittent divergent strabismus with a deviation measuring 6$^{\Delta}$ for near and 30$^{\Delta}$ for distance. A recession of the left lateral rectus of four mm. and of the right lateral rectus of five mm. resulted in no deviation for distance and 10$^{\Delta}$ esotropia for near.† This was treated orthoptically. Two years later, during which time the patient developed myopia, she was cosmetically perfect and showed no deviation under cover for near and approximately 6$^{\Delta}$ exotropia for distance.

Case 2. C. L., aged five years, intermittent divergent strabismus with a deviation measuring 9$^{\Delta}$ for near and 38$^{\Delta}$ for distance. Orthoptic treatment was given for a period of two months. A three-mm. recession of both lateral recti resulted in 16$^{\Delta}$ of exotropia for distance and 10$^{\Delta}$ of esotropia for near.

It should be pointed out that in measuring the deviation particularly in this type of strabismus, the prism cover test is used with special care, alternating the cover more slowly and attempting to overcorrect the deviation slightly with prisms, then returning to the neutral point.

Costenbader[3] described two cases of divergence excess which showed surgical overcorrection. Each resulted in a convergence excess (hyperkinetic accommodative concomitant squint). They are straight at 20 feet and at 13 inches until they accommodate, at which time the esotropia is apparent.

The inadequacy of recession of the lateral recti in cases of divergence excess is not only due to the danger of accommodative esotropia but also failure to completely correct the divergence for distance even when the near result is good. An example follows:

H. H., aged five years, first examined in July, 1953, at which time his deviation measured 34$^{\Delta}$ for distance and 10$^{\Delta}$ for near. His refractive error was +1.0D. sph. right eye, +1.25D. sph., left. At that time recession of both lateral recti and recession of one internal rectus was planned. Six weeks later the measurements of the deviation were the same. On September 24, 1953, in spite of the planned procedure, a four mm. recession of each lateral rectus muscle was done, resulting in no deviation for near and 16$^{\Delta}$ exophoria for distance. On August 24, 1955, the exophoric deviation measured 16$^{\Delta}$ for distance, 1$^{\Delta}$ for near.

In this instance, because of reluctance to recede the internal rectus the operation was limited to recessions of the external recti.

* From the Sinai Hospital and Wayne University.

† A typographical error showing 10$^{\Delta}$ exotropia for near is present in the original paper.

Cases of divergence excess with recession of the medial rectus

Case 1. B. R., aged six years, was first seen on February 19, 1953. There was a history of divergence since the age of three months. There was intermittent exotropia measuring 27$^{\Delta}$ for distance and 8$^{\Delta}$ for near. Cycloplegic refraction showed an error of +2.0D. sph. right eye and 2.25D. sph., left. Glasses were not advised. On June 30, 1955, the patient was found to have the same deviation. Surgery was advised as follows: recession of the right lateral rectus four mm., recession of the left medial rectus three mm., and recession of the left lateral rectus five mm. These procedures were carried out on July 14, 1955. On August 10, 1955, the exophoric deviation measured 10$^{\Delta}$ for distance and 4$^{\Delta}$ for near. On September 15, 1955, the measurements were zero for near, 5$^{\Delta}$ for distance.

Case 2. C. L., aged 11 years, was first seen at the age of five years when he had a horizontal deviation of the divergence excess type measuring 38$^{\Delta}$ for distance and 9$^{\Delta}$ for near. His refractive error was: right, +3.0D. sph. $\bigcirc$ +0.5D. cyl. ax. 90°; left, +1.5D. sph. $\bigcirc$ +0.5D. cyl. ax. 95°. Visual acuity was 20/30 right, 20/20 left, corrected. Glasses were not ordered. Orthoptic training was instituted for two months. Shortly afterward, on March 23, 1951, a three mm. recession of both external rectus muscles was done, resulting in 16$^{\Delta}$ exotropia for distance and 10$^{\Delta}$ accommodative esotropia for near. Glasses were ordered at this time. In October, 1953, the deviation was 18$^{\Delta}$ exotropia for distance and zero for near. The glasses were reduced by 0.75D. and ordered for close work. On March 12, 1955, the cycloplegic refractive error was: right, +1.25D. sph. $\bigcirc$ +0.75D. cyl. ax. 90°; left, +0.5D. sph. $\bigcirc$ +0.5D. cyl. ax. 100°. This was cut 0.5D. each eye and ordered. On July 11, 1955, the deviation was 12$^{\Delta}$ exotropia for distance and zero for near. On July 26th a recession of the left lateral rectus of four mm. and a recession of the left medial rectus of three mm. were done. The result was excellent. No horizontal deviation remained for distance or near in March, 1956.

Case 3. D. M., aged three years, was examined on August 23, 1954, because of divergence of the left eye since the age of 21 months. His refractive error under scopolamine was +0.75 D. sph. each eye. His deviation measured 17$^{\Delta}$ for near, 30$^{\Delta}$ for distance. Some underaction of each inferior oblique was present. On October 21, 1955, the deviation measured 14$^{\Delta}$ exotropia for near, 30$^{\Delta}$ for distance. A five mm. recession of each lateral rectus and three mm. recession of the left medial rectus were done. On December 17th the deviation measured 2$^{\Delta}$ exotropia for near and 9$^{\Delta}$ for distance.

Summary

Three cases of intermittent exotropia, in which the deviation for distance was significantly greater than for near, are presented. Successful surgical correction in each case required recession of both the internal and external rectus muscles.

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ON THE RELATION OF LABYRINTHINE STIMULATION TO DEVIATION OF THE VISUAL AXES*

A. The effect of prismatic lenses on vertigo

B. Deviation of visual axes after the Bárány turning test

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A. The effect of prismatic lenses on vertigo

A recent article by Katz,[1] dealing with the effect of ocular prisms on the vertiginous symptoms of Menière's disease recalled some work which I did a few years ago at Columbia University. My study at that time was stimulated by the work of the same two men to whom Katz refers—Utermöhlen and Baron.

The French ophthalmologist, Dr. Jean Baron of Paris, working at the Sorbonne and for a time at Columbia University, had, in 1951, provoked considerable interest in the question of the relationship which prism glasses might have to vertigo.[2] My approach to elucidating this possibility further was first to work with Dr. Baron, who had been studying the problem for some time, and then to carry out a series of studies of my own in Dr. Fowler's department at Columbia University.

During the time I observed Baron's work, his examinations were made as follows:

He employed the Maddox-rod test for measuring ocular deviation and for measuring the effect of his prisms. As I understood his aim, he did not attempt to correct the phorias present nor to correct any refractive error. He seemed to estimate the phorias by means of comparing the exposed scleras in the two eyes. He did not use the cover test. He did inspect the extraocular movements in the various fields of gaze. To judge the effect of prisms on equilibrium, he used line walking, standing on the floor on one foot, and standing on a stool on both feet; in the latter test he observed the comparative levels of the two shoulders and looked for a spinal curve.

Estimating deviation of the visual axes by comparing the amount of sclera exposed in the two eyes is not recognized as a sound method. The Maddox-rod test is accurate in measuring deviation but does not differentiate between deviation due to the phorias and other causes (accommodation, attempts at fusion, and so forth).

I was unable to judge the value of comparing the shoulder heights and the spinal curve with and without prisms because I could never make out the differences which he seemed to see. For me, they were very uncertain.

The line-walking test in certain individuals seemed to indicate that prisms had an effect.

Utermöhlen,[3] who first conceived the idea that vertigo could be controlled by prisms, described the first case which initiated this train of thought. This patient was a muscular individual who "overdid all muscular actions." When he used his eyes to look at something close at hand, he overdid his convergence, causing his eyes to cross, according to the author. Utermöhlen had the patient wear prisms base-in, which he claimed markedly alleviated the vertigo of which the patient had complained. One would strongly suspect that, when there was excessive muscle convergence, as a result of accommodation, a hyperopia was present but Utermöhlen did not record any refraction findings.

* From the Research Laboratory, St. Luke's Hospital. This study was supported by grants from the Louis W. and Maud Hill Family Foundation of St. Paul, the Edward C. Congdon Memorial Trust, Miss Elisabeth Congdon, and The Women's Service Guild of St. Luke's Hospital. The work was done in part while I was visiting research professor at Columbia University, Department of Otolaryngology (1951-52), and was supported by A.A.F. Grant No. 038 (33)27877.

Utermöhlen used a very simple test on his subjects, consisting of three turns to the right or three turns to the left. He would then place a half diopter prism base-in in front of one eye and turn the patient again. If the resulting dizziness were not controlled, he increased the prism by half-diopter steps to as high as two diopters. He recorded that the vertigo was controlled, in practically all of his subjects, with two prism diopters or less. He claimed that a large percentage of patients with Menière's syndrome were relieved of their vertiginous symptoms by prisms, as quoted by Katz, 90 percent of 1,000 cases.

Aschan[4] tested 100 candidates for military aviation, using the Bárány test with and without Frentzel lenses. He found that the post-rotational nystagmus was substantially increased by wearing the glasses. He does not state specifically if there was any effect upon the subjective vertigo. A prismatic effect, of course, would result from such lenses unless the interpupillary distance were accurately adjusted. Aschan does not discuss the possibility of such a prismatic effect on the subjective vertigo nor does he suggest it as a factor in the variation of the duration of the nystagmus.

Methods of study

My own studies concerning the effect of prismatic lenses on vertigo included seven tests:

1. Line-walking test.
2. Standing with the eyes first open then closed, (a) on two feet and (b) on one foot.
3. Hallpike test.
4. Kobrak test.
5. Utermöhlen test (rotating the patient on his feet).
6. Bárány test.
7. Cat experiments.

All of these tests were done with and without prisms. Except in No. 7, the prisms were placed in the trial frame before the eye and used in strengths varying from 0.5 to 6.0 prism diopters base-in and base-out. Sometimes base-in and base-out were used in combination, as done by Baron, that is, two prism diopters base-in before the right eye and one prism diopter base-out before the left eye, making a total of one prism diopter base-in.

Subjects

A number of the subjects used in this study were patients whose chief complaint was vertigo and some of the subjects were normal volunteers from among the laboratory personnel.

Results

1. In the line-walking test (table 1), a total of 89 tests were made. Just two subjects seemed to be subjectively much improved by the use of prisms.

One (Mrs. R. H.) could scarcely balance on her feet without prisms and could walk a line quite well with prisms. It made no difference, however, if she wore two prism diopters base-in or four prism diopters base-out, either one seemed to benefit her equally and she could walk the line.

The other subject (M) stated that she was without vertigo when wearing the prisms and not only could walk the line much better but her vision was very greatly improved with the prisms. These improvements were common to all the prisms tried on this patient, from one prism diopter base-in to four prism diopters base-out. Objectively there was no improvement in the line walking. There is no reason to believe that prisms would improve visual acuity. The will to believe was exceedingly strong in this individual.

2. Standing with the eyes first open then closed (a) on two feet and (b) on one foot. These tests were made with and without prisms and proved to be inconclusive and unsatisfactory.

3. Hallpike test. A number of tests were attempted with the Hallpike (30 and 44 degrees caloric stimulation), all of which were inconclusive. Prisms produced no definite change in the duration of the nystagmus and the subjective effect on the vertigo was uncertain.

TABLE 1

LINE-WALKING TEST*

Subject	Pathology	Number of Tests	Prisms		Results
			In	Out	
			(prism diopters)		
H. H.	10th day postoperative fenestration	28	0 to 4	0 to 4	Negative
A. S.	6th day postoperative Day operation	10	0 to 4		Negative
M.	Cholesteatoma with labyrinthitis	14	1 to 4	2 to 4	Negative objectively. Subjectively—better with all combinations including 0[b]. Will to believe unusually strong.
H. C.	Indefinite dizziness	4	1	1	Negative
L. W.	Sudden episodes-rotational vertigo with nausea	3	1	1	Negative
R. H.	Undiagnosed vertigo	6	1 to 4	0 to 5	Positive—subjectively and objectively. In or out made no difference.
M. K.	Streptomycin 2 gm./da. Tubercular kidney	8	2 to 3		Negative
C. J.	Normal	7	3 to 4	0 to 4	Negative
E. G.	Normal	9	1 to 6	1 to 3	Negative

* Eighty-nine tests were made on nine subjects; only two subjects showed subjective improvement and only one showed objective improvement in line walking with the use of prisms. In the latter instance, it made no difference if the prisms were base-in or base-out.

4. Kobrak test. The stimulus from the Kobrak test was too variable for our purposes and the test was discarded.

5. Utermöhlen test. Ninety-seven tests were made by Utermöhlen's method on eight different subjects (table 2). Eighty-two of these were entirely negative. It made no difference in the vertigo whether the subject was wearing prisms or not, nor did it matter if the prisms were base-out or base-in and the strength of the prism also seemed irrelevant.

In one subject (E. G.) the vertigo became worse, as timed by a stopwatch by the subject himself, when a total of six prism diopters base-in was placed before his eyes. This was close to the breaking point of fusion and it was difficult for the subject to avoid seeing double.

A second subject (R. D. O.) gave nine negative responses and two positives in that the prisms made him very much more dizzy. In one of these tests he wore four prism diopters base-out and the other five prism diopters base-out.

Another subject (R. G.) in eight tests showed improvement in vertigo from zero prism diopters (base-in and base-out neutralizing one another) to a total of two prism diopters base-out. This was the same patient who showed improvement in the line walking with any prism tried—base-in or base-out.

6. Bárány test.[5] Twelve tests were made with the prisms (1.5 to two prism diopters), in 11 base-in, in one base-out, after turning in the Bárány chair. The response, as far as nystagmus was concerned, was reasonably uniform. In the 12 tests, the duration of nystagmus, comparing with and without prisms, was longer in five, with prisms, shorter in four, and unchanged in three. Subjective vertigo was slightly improved in three, made

TABLE 2

UTERMÖHLEN TEST

Subject	Pathology	Number of Tests	Prisms (prism diopters) In	Prisms (prism diopters) Out	Results
C. G.	Undiagnosed rotational vertigo	18	0–2	2 & 6	Negative
R. D. O.	6 sudden attacks of vertigo	11	2–3	4 & 5	9—negative. 2—positive. Definitely worse with 4^{Δ}out and 5^{Δ}out, subjectively and objectively.
L. W.	Sudden transient rotational nystagmus	9	1 & 2		Negative
R. H.	Undiagnosed rotational nystagmus	8		0 & 2	Positive—improved. With 2^{Δ}out clipons. Better with prisms and worse without Power and direction insignificant.
C. J.	Normal	12	1–4	2 & 4 (Vertical 2–4)	Negative
E. G.	Normal	14 3	1–4 6	2 & 4	14—negative. 3—subjectively positive. Subjectively vertigo doubled in time with 6^{Δ}out.
H. M.	Normal	12	1–4	2 & 4 (Vertical (1–2)	10—negative. 2—questionable—(2^{Δ} and 4^{Δ} out less vertigo.)
M.	Normal	10	1–6	2–4	Negative. Subjectively slightly worse with 4^{Δ} & 6^{Δ} in.

worse in three, and unchanged in six. The duration of vertigo was increased in two, shortened in three, and in six was not recorded (table 3).

7. Some experiments were done on a number of cats, destroying one labyrinth. When the cats recovered sufficiently so that they could walk, with difficulty, prisms were put on them and attempts made to determine if the animals walked better. These tests also were inconclusive. (See details in table 4).

B. Deviation of visual axes after the Bárány turning test

It has been found that the visual axes deviate in some individuals following vestibular stimulation by means of the Bárány turning test.[2] The question arises as to whether this deviation results from the stimulation of the vestibular organs or whether it is due to something else.

The oculogravic illusion described by Graybiel[8] is, in part at least, a labyrinthine phenomenon, although Graybiel does not emphasize that feature. This phenomenon occurs when a subject is seated upright on a revolving turntable some five meters from the center. It results from a combination of stimuli: visual, tactile—pressure upon the skin from centripetal force and the force of gravity, and labyrinthine—from the action of the same forces upon the otoliths of the utricle and saccule and upon other organs and tissues of the body. Graybiel feels that the semicircular canals do not enter in unless acceleration of rotation is too fast. The character of the il-

TABLE 3

BÁRÁNY TEST

Subject	Prism (prism diopters)	Number of Tests	Change in Muscle Balance Before & after Turning (prism diopters)	Vertigo Time Subjective	Nystagmus
M. W.	1.5 in	1	0	Slight improve* (3 sec. longer)	Slight longer—3 sec.
		1	0	No improve	Same
A. M.	2 in (corrected 6 in, prism test = 8 in)	1	0	No improve (1 sec. +)	2 sec. longer
		1	1 exo to 0 = 1 conv.	No improve (1 sec. −)	1 sec.
C. B.	1 in	1	0	No improve (?)	3 sec. longer
		1	0	No improve (?)	Same
R. R.	1.5 in	1	—	Worse—4 sec. less	3 sec. less
		1	—	Worse—7 sec. less	8 sec. less
D. R.	1.5 in	1	0	Worse	3 sec. longer
D. L.	2 in	1	0	Slight improve (?)†	Same
	2 out	1	(?)	Slight improve†	3 sec. less
S. W.	2 in	1	Not recorded	No improve	3 sec. less
		12	7—no change 1—exo. decr. 1$^{\Delta}$ 4—not recorded	3—slight improve†* 6—no improve 3—worse 2 longer 3 shorter 6 not recorded	5 longer 4 shorter 3 same

* Claimed slightly less vertigo in control tests before prism was added. Grew less dizzy each time with or without prisms.

† Patient thought dizziness was a little better after one test. Later stated that prisms did not improve vertigo. Was very dizzy first control run, less with second control and still less with prism.

lusion depends upon which sense dominates. It is usually characterized by a displacement in the environment and a sense of tilting of the body. Rotation of the environment may be elicited under certain circumstances. Rotation and displacement may occur simultaneously.

When a subject is being rotated in a turning chair, his head tends to turn in the direction opposite to that of rotation. This is a manifestation of the righting reflex, which reflex is a labyrinthine phenomenon.

The complicated compensatory fixation reflex,[7] by means of which the eyes can be maintained in continuous fixation upon a stationary object in the environment during movements of the head, is another labyrinthine function. It is a postural reflex concerned in maintaining equilibrium and dependent upon the utricle and saccule, the semicircular canals, and the muscles of the neck and back.

Postrotational nystagmus, during which the environment rotates, is labyrinthine, and is sometimes of importance in aviation.[8] There are other labyrinthine effects, such, for instance, as the effect of labyrinthine stimulation on the fusion frequency of flicker[9] and the effect upon retinal after-images.[10, 11]

The righting reflex, the compensatory fixation reflex, and nystagmus are all involved in the Bárány turning test and are all under labyrinthine control. It is only natural to assume that the displacement of the image due

TABLE 4

CAT EXPERIMENTS

One labyrinth was destroyed in each of six cats.

TECHNIQUE:

Under general anesthesia a midline incision was made through which one or the other of the otic bullae was exposed and opened. The round window was located and a hypodermic needle pushed through this and the tip forced into the vestibule to a position behind the oval window. A few drops of alcohol were injected.

After this operation, the animals were very unstable for some days but gradually improved. Some did not survive—apparently because they refused food.

CAT 1

The right labyrinth was destroyed on 10-2-51. After the operation, the right pupil was smaller than the left and a marked nystagmus was present. The animal tended to fall toward the right and to twist its head so that the right ear was down and the head turned toward the left. This animal would not eat and died on 10-8-51—six days after the operation. At autopsy, the wound looked clean and there was no meningitis.

CAT 2

The right labyrinth was destroyed on 10-8-51 by H.M. The animal showed no postoperative labyrinthine disturbance.

CAT 3

This animal died from the anesthetic.

CAT 4

The left labyrinth was destroyed by the above technique by H.M. on 11-13-51. Following the operation, the left pupil was small and the animal was very unsteady. There was a marked nystagmus toward the right and the head was held inclined toward the left. The animal was very reluctant to move.

On 11-19-51, the sixth postoperative day, the cat was tested with prisms. The prisms were held before the eyes in a specially constructed frame. The animal was very unsteady and the results were uncertain. The prisms did not seem to make any difference.

Again on 11-26-51 prisms were tried. The combinations tried—five of them—varied from 2^{Δ} in to 4^{Δ} out. Again the prisms made no demonstrable difference in gait.

CAT 5

The left labyrinth was destroyed on 11-13-51. The cat showed signs of labyrinthe disturbance the next day. The gait was unsteady. There was a horizontal nystagmus toward the right. The left pupil was smaller than the right and there was a left ptosis of the lid. This animal also presumably died. The record ceases without notation of death.

CAT 6

The right labyrinth was destroyed by operation as above on 11-13-51 (ACH).

On 11-14-51, the head was inclined toward the right. The gait was unsteady and there was a marked nystagmus toward the left. The right pupil was smaller than the left.

By 11-19-51, the nystagmus was gone and the gait, while unsteady, was much improved.

Prism combinations were tried to make 2^{Δ} in, 2^{Δ} out and 4^{Δ} in. The prisms had no definite influence upon either the unsteadiness or the gait.

The experiment was repeated on 11-26 with the same result.

On 11-27, the animal was found dead in the cage.

to deviation of the visual axes resulting from stimulation of the same ocular muscles which are producing rotation of environment, at the same time and under the same circumstances, is also due to labyrinthine activity. More especially, perhaps, since the effect lasts an appreciable length of time after the cessation of turn. However, under the fusion free conditions of the Maddox-rod test, it is not necessarily true that this deviation is also due to labyrinthine stimulation. Fixation, accommodation, convergence, and attempts at fusion[12] also enter in with other reflexes and certain voluntary movements, which are not under labyrinthine control.* Any or all of these reflexes might combine to cause the deviation measured by the Maddox-rod test.

When fusion is broken by the Maddox rod,

* Perlman and Case[12] give an excellent discussion of the inter-relationship between voluntary eye movements controlled by the frontal cortex, reflex optic movements which are controlled by the occipital cortex, activated by retinal reflexes, and the reflex vestibular movements, which are controlled in the cerebellum and activated by the end-organs in the labyrinth. These inter-relationships must be understood before eye movements can be analyzed.

the extraocular muscles no longer hold the visual axes parallel. The eyes tend to move toward the position of rest. More accurately speaking, they move toward the "fusion free" position.[12] The Maddox-rod test measures the deviation with great accuracy but does not label the cause of the deviation.

Convergence and accommodation are both under voluntary control. The two are so closely related in action that they cannot be separated with facility. They are habitually used together. The other vergences—divergence, left and right hypervergence—are not under voluntary control. When fusion is broken by the Maddox rod and the subject sees two images—a white light and a red streak—he tends to be confused. It is difficult to keep both in view at the same time. The eye covered by the Maddox rod tends to suppress, the locus of the red streak in space is indefinite, and, in attempting to locate it and fix it, the subject often accommodates and this results in an associated convergence. Hence the shift in position of the streak. As accommodation and degree of convergence vary in trying to locate the streak, the position of the streak in relation to the light also changes. This shifting is likely to be accentuated if the subject attempts to fix the streak rather than the light. He may also attempt to fuse. Changes in fusion cause rather slow movements in the visual axes.[11]

If, under these circumstances, further confusion is added by the nystagmus and vertigo following turning, the resulting movements of the red streak must be very carefully evaluated before any significance, as far as the labyrinth is concerned, is attached to them.

The present study is made for the purpose of determining if the deviation which occurs following turning in the Bárány chair is due to labyrinthine stimulation.

Observations

The subjects used in these tests were, with two exceptions, freshman medical students, and these two exceptions were patients.

The Maddox-rod test was used in the usual manner with this variation: The white light had been placed in the center or zero position of an arc constructed of plastic board (masonite) upon which the deviations in prism diopters had been previously marked and which was so placed before the turning chair that the subject faced it when the chair was at rest. As the subject reported the position of the streak on the arc, the deviation could be read off directly in prism diopters.

The test was made under the conditions of four different situations:

A. Control conditions before turning in the Bárány chair.

B. Immediately upon stopping the chair at the beginning of the period of postrotational nystagmus and vertigo.

C. At the end of the period of postrotational nystagmus and vertigo.

D. Some of these repeated with the subject wearing a small prism before his eyes, placed with the base-in (the 12 reported above).

During the control tests (A), the subject was instructed to fix the white light and the red streak alternately. He was urged especially to get the red streak into clear view. This often caused attempts at fusion or caused his accommodation and convergence to vary somewhat. In any case, the red streak varied in position. The resulting variations in the angle between the visual axes were determined by reading off the position of the red streak on the arc as reported by the subject.

During the postrotational tests, the subjects were instructed to look at the white light always and these readings were compared with those made in the control tests when the white light was fixed. In the tests made immediately upon stopping the chair (B), the subject was instructed to look at the white light as soon as the chair had stopped and report the position of the red streak. All found this difficult to do because of the nystagmus but most managed to report satisfactorily. Meanwhile, the operator started the stopwatch immediately upon cessation of rotation, for the purpose of timing the nys-

tagmus. The subject reported the cessation of vertigo and this also was timed.

When both nystagmus and vertigo had ceased, another reading of the position of the red streak was made (condition C).

Results

A. Nine control tests were made on seven different subjects. With the Maddox rod in place before the right eye, the subjects were told to fix alternately the white light and then the streak. Convergence resulted in looking from the light to the streak in six of the tests. The amount varied from one prism diopter to seven diopters. Four of these were 1.75 prism diopters or more. Divergence occurred in three. One diverged one prism diopter and the others two prism diopters each. The convergence averaged 2.85 prism diopters and the divergence 1.75 prism diopters.

B. There were 25 determinations of change in visual axes taken immediately upon cessation of rotation at the beginning of postrotational nystagmus and vertigo with the subject fixing the white light. In 13 a convergence was found, in 12 there was no deviation. Of the 13 in which convergence was found, the change consisted of increased esophoria in seven and a decreased exophoria in three. In two a small exophoria became an esophoria. In one there was no record of the phoria although the amount of change and the direction were given. The order of magnitude of change, one to eight prism diopters, was about the same as in the control tests—one to seven prism diopters. The average was 3.50 prism diopters.

C. There were 24 turning tests made in which the Maddox reading was made both at the beginning and at the end of the period of postrotational nystagmus; that is, immediately upon stopping the chair and after the nystagmus had ceased. During this period when nystagmus and vertigo were decreasing, there was a divergence in 12 and no change in 10. In only two was there a convergence. One (0.25 prism diopter) was within experimental error and possibly the second also (one prism diopter). All exhibited nystagmus for periods varying from 22 to 30 seconds—those which indicated no change as well as those which diverged.

D. Reported in Section A of this paper (table 3).

Discussion

These studies on the effect of prisms upon vertigo were inconclusive inasmuch as they showed no such effect. They do not rule out the possibility of a controlling effect during attacks of Menière's syndrome, since none of the subjects were tested during attacks. The etiologic factor in the vertigo described in the histories of some of the patients was indeterminate but, in others, the vertigo was that which commonly follows fenestration operations. Nevertheless, if prisms were as effective in controlling vertigo as Utermöhlen's articles indicate, then there should have been some positive effects apparent in such a series of tests.

A deviation of the visual axes, resulting in displacement in the environment under the conditions of the Maddox-rod test, occurs in some individuals after rotation in a Bárány turning chair. Nystagmus also occurs, resulting in rotation of the environment. Thus, as in the oculogravic illusion, both rotation and displacement of environment may occur simultaneously. However, if the amount of stimulus is known, the oculogravic displacement can be predicted approximately as can the duration of the nystagmus. The displacement due to deviation of the visual axes, as in these turning tests, is not predictable. It occurred in only about half the subjects.

If this phenomenon were a result of labyrinthine stimulation, one would expect it to occur in normals each time the labyrinth is adequately stimulated. The stimulation in the Bárány turning test as used in these experiments is not only adequate but is, in fact, rather violent. If this deviation were due to labyrinthine stimulation, one would expect it to parallel the other signs of stimulation such as nystagmus and vertigo, at least roughly.

This it did not do since it failed to appear at all in about half of the tests. Vertigo and nystagmus occurred in all.

Moreover, in control tests made before rotation, the displacement of the red streak to about the same extent as that which followed rotation was produced merely by asking the subject to "look hard" at the streak and then at the light. This served to encourage accommodation. The shift during turning, as indicated by readings taken immediately upon stopping the chair, if it occurred at all, was always in the direction of convergence (the only voluntary vergence), as though the subject were accommodating or attempting to fuse. The shift which occurred during the postrotational period, as the nystagmus and vertigo subsided, was in the direction of divergence—in other words, relaxing convergence. There were two exceptions to this, at least one of which was in the range of experimental error.

The question naturally arises, why did not convergence occur in all? One can only say that probably all did not accommodate (or attempt to fuse). These are voluntary functions. There was no real need to vary the accommodation since the light always remained at the same distance. Yet, in attempting to see, under difficult or unusual circumstances, many subjects do vary the accommodation even when the distance remains constant.

Conclusions

The effect of prisms on vertigo was inconclusive as far as the seven tests reported were concerned. The total number of trials in each of the seven tests was not large, but, if the beneficial effect of prisms is as common and as uniform as Utermöhlen maintains, then such effects should have been found in these tests.

The deviation of visual axes following the Bárány turning test, as evidence by the Maddox-rod test, does not appear to be a result of stimulation of the labyrinth. Rather it seems to be a manifestation of the accommodation-convergence or fusion reflexes, or both of them.

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NOTES, CASES, INSTRUMENTS

INTRA-EPITHELIAL CARCINOMA OF THE LIMBUS*

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Normal conjunctiva or corneal epithelium of the limbus in adults can show metaplasia to squamous-type epithelium. This may occur in any inflammatory process and may be the forerunner to the development of more serious lesions, the formation of epithelial tumors of the limbus. This altered epithelium may undergo one of three changes (Ash[1]): leukoplakia, dyskeratosis or a papilloma formation, and, finally, frank squamous- or basal-cell carcinoma. Dyskeratosis can lead to leukoplakia or to the classic Bowen type lesion of intra-epithelial carcinoma. The altered leukoplakia changes into frank squamous- or basal-cell carcinoma. The metaplasia usually extends well beyond secondary alterations and is a potential source for recurrence.

In 1912, Bowen[4] described precancerous dyskeratosis of skin and mucosa which would become malignant if not treated. But only in 1942, McGavic[3] reported five cases of Bowen's disease involving cornea and conjunctiva. All other cases that previously have been reported were found in mucosa or skin.

Bowen's disease in the epithelium of the limbus is described as slightly elevated, diffuse, highly vascularized, reddish-gray, gelatinous tissue arising from the epithelium, and remaining within the epithelium for years without breaking the basement membrane. McGavic also believes that Bowman's membrane evidently offers a barrier to invasion, although Bowen's epitheliomas are said to be capable of metastasizing without invasion.

In the skin the microscopic picture shows thickened epithelium, hyperplastic deranged plaques formed by rete cells giving a papillary appearance. Epithelial cells vary in size, shape, and staining. Bizarre mitosis and disordered polarity are seen. Single nuclei may appear enlarged to monster cells or multinucleated with clumped nuclei, as seen in the "clumping cells" of Bowen. Division is by amitosis. The cytoplasm appears vacuolated, often giving a double ring appearance of the cells; the so-called "corps ronds" of Darier. Intercellular bridges with surface cornification and parakeratosis with granular formations are seen.

The basal cells may proliferate and lose their pallisade arrangement. The basement membrane stays intact without evidence of invasion into underlying stroma. Plasma cells and histiocytes infiltrate beneath the epithelium and the vascularity gives the false impression of an inflammatory process. The cellular variations, the "poikilokarynosis of Darier," are necessary for the diagnosis of Bowen's disease.

On the limbus the extension is usually into the cornea. The change from normal epithelium to new growth is abrupt. Between the tumor and Bowman's membrane, inflammatory reaction and new blood vessels can be seen. The cancerous changes in Bowen's disease are slow. A group of atypical squamous-cell epithelium may arise from portions of Bowen's lesion and form an ulcerating or fungating tumor mass locally infiltrating but not metastasizing.

Bowen's epithelioma has been found to originate in pannus crassus of trachoma, 14 years after injury to the eye, and also in corneal burn. Other factors that contribute to change in the covering epithelium are heat, dryness, irritating dusts, and, most important, ultraviolet radiation.

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The growth can be rather rapid. Lesions have been noted to develop in less than six months. Differential diagnosis has to consider ordinary basal-cell or squamous-cell carcinoma, xeroderma pigmentosum, arsenical keratosis, precancerous melanosis, intraepidermal melanoma, senile keratosis, radiation dermatitis and carcinoma, leukoplakia, paraffin workers' carcinoma, so-called epithelial plaques or congenital benign epithelioma of the limbus. The diagnosis is established by biopsy which is safe to perform.

Stout[5] has already stated that Bowen's disease is less susceptible to X-ray treatment, and that the best treatment is surgical excision. He is borne out by Ash.[2] Ash finds that 32 out of 34 cases of Bowen's disease of the limbus were healed without recurrence. Although the lesion has a tendency to extend over the cornea more than toward the periphery, it can be stripped away from Bowman's membrane leaving clear cornea. Penetration of the sclera is extremely rare.

There is common consensus that whatever the origin and even long duration in situ with invasion or metastases, Bowen's disease is potentially a malignant neoplasm. The epidermalization or metaplasia usually extends well beyond the secondary alterations and may be the ground for recurrence and should be excised with the tumor.

Case report

S. B., a 73-year-old white man, was seen at the office on June 13, 1955, because of irritation and scratching of the left eye which had begun about 10 to 14 days previously. About five days later some redness was noted at the outer limbus. He had bilateral combined cataract extractions about 14 years ago. The right eye apparently was operated without any difficulty, intracapsular; in the left, evidently, the capsule had ruptured because three more procedures were undertaken; the details are unknown. The right eye showed a total iris coloboma of good size at the 12-o'clock position. The media were clear. Fundus showed a moderate sclerosis of the vessels. Vision was corrected to 20/20 and J1. The left eye showed a large coloboma with a fixed pupil three mm. in diameter. There were capsule remnants along the iris margin containing some organized pigment close to the chamber angle of the lateral border. The media otherwise were clear and the fundus showed the same vascular pattern as on the right. Vision was corrected to 20/30+ and J1.

On the lateral limbus of the left eye, straddling the horizontal meridian and reaching slightly lower down than upward, was a slightly elevated triangular area based on the limbus and sending two small gray pedicles onto the cornea. It measured about 3.5 mm. at the base and was 5.0 mm. high. It appeared red and injected. Filled vessels, mostly conjunctival, were reaching it from the outer canthus. Under the slitlamp, the surface appeared uneven but there was no apparent break in the epithelial cover. The change from normal conjunctiva to tumor was a sharply delineated rise of nearly one mm. Except for its shape it gave the impression of a base of a pterygium.

The remainder of the conjunctiva of the globe and the lid, as well as the sclera, especially in the line of the cataract incision, did not show any abnormality. No lymph gland enlargement was noted. The location, as well as the appearance, suggested tumor rather than inflammation, and the patient was advised to have a biopsy done. He consented and this was done immediately.

The biopsy report (Dr. McAdams) read:

"There is an abrupt thickening of the normal appearing epithelium with marked acanthosis and proliferative activity up to the surface (fig. 1). The cells are enlarged and somewhat atypical with enlarged hyperchromatic nuclei showing slight to moderate anaplasia and mitotic activity. There is preservation of the normal basal epithelium without evidence of invasion (figs. 2 and 3). The changes are consistent with intra-epithelial malignancy."

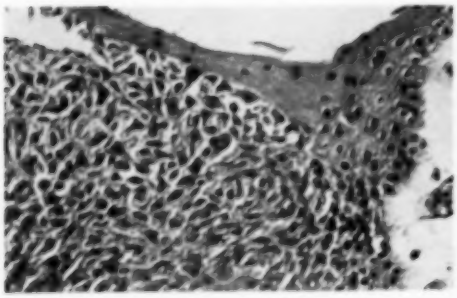

Fig. 1 (Dinolt and McAdams). Biopsy of lesion, showing transition from normal stratified squamous epithelium to markedly thickened, proliferative epithelium.

The diagnosis was intra-epithelial carcinoma of conjunctiva.

The patient immediately consented to have the whole tumor removed and this was done at the Day Kimball Hospital on June 27, 1955. Preoperatively an attempt was made to obtain a Papanicolaou smear from the area. The cells were reported: Class III —doubtful. Suspicious cells present. Not diagnostic of malignancy (fig. 4).

Under surface and infiltration anesthesia the conjunctiva was separated from the sclera, the lesion excised with what appeared to be adequate margin, and the corneal epithelial plaques lifted off with a Graefe's knife, showing clear stroma underneath. The conjunctiva was approximated and healed normally. When seen on August 1, 1955, only a thin scar could be noted with slightly distended vessels.

Fig. 2 (Dinolt and McAdams). Another view, demonstrating the thickened disorganized epithelium arising abruptly from just above an intact basement membrane, with on evidence of beginning invasion.

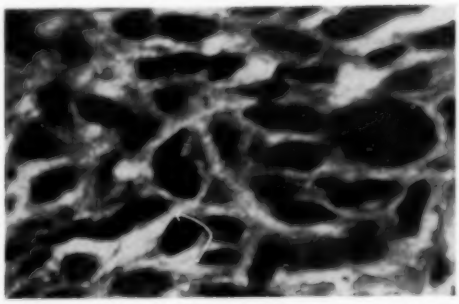

Fig. 3 (Dinolt and McAdams). Detail of biopsy. The marked variations in size and shape of cells and hyperplastic nuclei are apparent.

The tissue was again reported as definite intra-epithelial carcinoma. Cells were in disorderly pattern, some anaplasia and scattered mitosis in all layers, and no evidence of invasion into the underlying stroma. There appeared to be a margin of normal epithelium

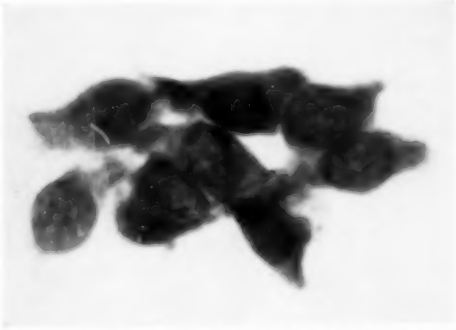

Fig. 4 (Dinolt and McAdams). Detail of Papanicolaou smear taken from the conjunctival surface at the time of excision. The cytoplasmic nuclear ratio is disturbed, with the presence of large nuclei, with a moderate degree of hyperchromatism, and slight to moderate prominence of the nuclear membrane. The cells appear quite suspicious but are not diagnostic.

present in the fragments. On August 1st, another Papanicolaou smear was taken and the cells were reported: Class I—negative, as was another taken 10 weeks later.

Comment

We are reporting this case because the number of cases of intra-epithelial carcinoma of the limbus is not great, and we want to draw attention to the attempt to support the diagnosis with a Papanicolaou smear, a relatively simple procedure which can be performed without frightening the patient unduly, or in a case when the patient refuses biopsy. Histologic description places our case in the category of Bowen's disease with its poikilokarynosis and intact basement membrane. The origin might be similar to McGavic's injury case only that the injury here probably was the incision for the cataract operation 14 years ago. Rather rapid development is borne out by the fact that, after removal, the patient felt completely relieved, and there was no doubt in the patient's mind that his symptoms were of recent origin.

It is planned to use Papanicolaou smears in the follow-up of this patient to detect possible recurrences.

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NYSTAGMUS

In a case of acrocephaly with albinism followed by cerebral thrombosis

A case report

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This report describes a patient with two unusual congenital anomalies, acrocephaly and albinism, who withstood a cerebral thrombosis at the age of 50 years. Some features of congenital and acquired acrocephaly and albinism with nystagmus will be discussed.

Acrocephaly is a deformity of the skull which is associated with premature closing of the sutures, or craniostenosis, particularly the coronal suture, causing the head to have a longer vertical diameter but shorter anteroposterior and lateral diameters than normal.[5, 13, 18]

Albinism is characterized by lack of pigment in the body, particularly in the eyes, skin, and hair, and is due to the inheritance of a recessive character transmitted by a partially sex-linked mosaic of genes.[5, 20] Albinism may be complete or partial. Our patient shows almost complete lack of pigment. Severe degrees of albinism are associated with very poor visual acuity, photophobia, and pendular nystagmus when gazing in any direction.[24] Nystagmus is a rhythmic alternating tremor of the eyes, and in pendular nystagmus the alternating to-and-fro movements are equal in rate and amplitude. The nystagmus on direct forward gaze of our patient was temporarily arrested by the intravenous injection of a small amount of barbiturate, enabling us to visualize the fundi satisfactorily.[14]

Case report

History. M. L., a 50-year-old, right-handed stock clerk, was admitted to hospital in June, 1945, complaining of progressive weakness and numbness of his left arm and hand, which developed during the course of the past eight hours. Examination disclosed a left hemiparesis which was more pronounced in the face and hand than in the leg. X-ray examination of the chest showed a hypertensive configuration of the heart but blood-pressure readings were consistently within normal limits. Serology, blood chemistry studies, and spinal tap were negative. The patient improved slightly and was discharged a week later with the diagnosis of thrombosis of the branches of the middle cerebral artery on the right.

He next came under study in 1951, when he complained of weakness of the entire left side of the body.

He stated that he had always been an albino. Details of his early history could not be obtained but the patient stated that he had never consulted a physician previous to his hospitalization. He had noticed that his eyes were sensitive to sunlight in the summer and that his skin became irritated with sunshine. Vision was poor even with spectacles.

Examination showed a left hemiparesis, the upper extremity being the most affected. The left plantar reflex was equivocal without being Babinski in type. The patient circumducted the left foot on walking. There was a sensory defect in all modalities of sensation on the left side of the face and body, best demonstrated by double simultaneous stimulation.

The skull was narrowed, being shortened in its anteroposterior diameter, and appeared of smaller volume than normal. The percussion note over the skull was high pitched. The testicles were undescended and a deep dimple was present in the pilonidal region. Blood pressures were within normal limits.

Mental status revealed a clear sensorium. An estimate of borderline mental deficiency was made. There was a tendency toward prolixity in verbal responses with occasional facetiousness that was inappropriate. The remainder of the general and neurologic examination was within normal limits. Serology, blood, and urine studies were again negative.

Special examinations. Full scale intelligence quotient was 86. Psychometric tests also demonstrated striking loss of visuomotor co-ordination, and there were many signs which are seen in patients with organic disease of the brain. The skin, hair, mucous membranes, and eyes showed no pigmentation except for a suggestion of reddish tint in the axillary hair and the beard.

Eye examination showed reddened lids and clear blue irises, and both globes transilluminated well. Both eyes showed a slow pendular nystagmus in all positions of gaze. Visual acuity was 10/200 in either eye, corrected to 10/70 by a +4.0D. sph.

In order to arrest the nystagmus, pentothal sodium, 0.065 gm., was given intravenously and nystagmus was abolished for approximately 14 minutes, without producing sleep. The ocular fundi showed no pigment (which gave the illusion of a small optic disc) and optic atrophy was not present. The fundal blood vessels showed some increase in tortuosity and nicking. Peripheral visual fields were within normal limits by confrontation. The patient showed a compensatory nodding motion of the head in rhythm with his nystagmus.

X-ray studies of the chest showed a scoliosis in the thoracic region, with its convexity to the right. Stereoscopic X-ray examination of the skull showed the total cranial volume to be smaller than usual, the anteroposterior diameter being excessively shortened. Radiologic diagnosis of the skull was acrocephaly and plagiocephaly.

Electroencephalography showed a small amount of abnormal slow waves (two to five cycles per second) derived from both temporal regions.

Discussion

Acrocephaly was first reported by Lycosthenes in 1557.[14] In both congenital and acquired acrocephaly premature synostosis of the cranial sutures has taken place and the skull is small.[17, 21, 27] The congenital form is due to, as yet unknown, factors of inheritance or antenatal disease; familial cases are extremely rare.

Acquired acrocephaly is said to follow injury or disease of the skull in infancy or childhood.[1, 2, 4, 6] Because head injuries in children are relatively common and acrocephaly quite rare, we are inclined to question injury as a cause of acrocephaly.

Mental deficiency is found in some cases but not all.[4] Greig, in his encyclopedic study, cites as his first case an individual with nystagmus, defective eyesight, constant tremor of the head and neck, and mental deficiency; his second case, however, was that of a 56-year-old man who had hemiplegia for 10 weeks and had good intelligence. Just as there seems to be no positive correlation between the size of the brain and the intelligence of normal individuals, there seems to be no correlation between the small cranium and intelligence of acrocephalics.[22, 23]

Ocular disease is often found as a result of the acrocephalic deformity.[11] The vertical

diameter of the orbit may be decreased by as much as 10 mm. Exophthalmos is relatively frequent, at times being so marked that dislocation of the eyeball may take place.[3] Optic atrophy and nystagmus are seen. Since the base of the brain may be deformed and the foramina constricted, Greig suggests that visual disturbances may be due to smallness of the foramina, increase in intracranial pressure, upward deflection of the (optic) nerve with displacement of the brain, defective arterial blood supply, and restricted venous return.[16]

Vascular disease of the brain, in those acrocephalics who reach mature or middle years, also appears with fair frequency. Whether this be due to coincidence because of the relatively high frequency of cerebrovascular disease, or associated with the chronic constriction of cerebral arteries as they enter the skull, remains to be settled.

Rhinorrhea is a not infrequent complication of acrocephaly because the cribriform plates in the base of the skull become both thinned and sharp pointed. A piece of bone may crack and then tear the dura, thus causing the leakage of cerebrospinal fluid through either or both nostrils. A small portion of frontal lobe of the brain may protrude into the nasal cavity. Surgical treatment consists in the amputation of this herniated nubbin of brain, and repair of the dura on both sides.

Albinism is a medical curiosity which has been known since early antiquity and studied extensively by the methods of modern medicine.[12, 15, 20] The lack of pigment in the eye of albinos produces a pale-blue iris, while through the pupil one sees a red reflection. Because of the lack of pigment, photophobia is present. Probably because of lack of pigment and the resultant scattering of light around the macula, a poor visual image is formed, and the eyes perform "pursuit movements," wandering to and fro in search of a better visual image. Thus pendular nystagmus develops and a central scotoma appears. Duke-Elder states that nystagmus is almost a constant feature of albinism and is due to defective maculas, noting that in most, but not all reports, the maculas are absent in albinos and the yellow pigment about the macula is absent as well. However, the perception of color, dependent upon cones which are found in and around the macula, is normal in albinos.

It is difficult to locate and study the macula, a tiny spot in the fundus, in an albino who has both photophobia and nystagmus. In our patient we were able to arrest the nystagmus temporarily by the intravenous injection of a small amount of barbiturate, a technique which is known to arrest nystagmus on forward gaze, regardless of cause.[18] The macula in this instance was normal, although there was no pigment seen about the macula.

Treatment of albinism is symptomatic. Although Garrod notes that albinos may have a lower resistance to infection than normally pigmented individuals, no practical therapy has been suggested. Ocular treatment of albinos includes use of dark lenses and tattooing of the cornea.

Summary

This report describes a patient with acrocephaly, a form of craniostenosis, and albinism with nystagmus who withstood a cerebral thrombosis at the age of 50 years. Some features of acrocephaly and albinism are discussed. Mental abnormalities and rhinorrhea are associated with acrocephaly. It is suggested that acrocephalics may be subject to cerebral thrombosis because of constriction of the major cerebral vessels as they enter the skull.

Albinism is characterized by lack of pigment in the body, particularly eyes, skin, and hair, being due to inheritance of a recessive partially sex-linked mosaic of genes. Severe albinism is associated with poor visual acuity, photophobia, and pendular nystagmus when gazing in any direction.

Our patient, a 56-year-old man, was admitted because of a left hemiparesis due to

thrombosis of branches of the right middle cerebral artery. He showed subtotal lack of pigmentation throughout his body. The eyes presented typical findings of albinism, including nystagmus. The nystagmus was arrested by small dosage of barbiturates intravenously, permitting further study of the ocular fundi. The skull was small and vertically elongated and on X-ray examination showed typical signs of acrocephaly.

147 East 50th Street (22).

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SYMPOCAINE*

A NEW LOCAL ANESTHETIC

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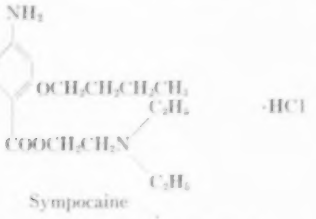
New York

For the past several years Clinton and Salvador[1] have prepared a series of esters of paraminobenzoic acid in which the hydroxy group in the 2-position is replaced by various alkoxy side chains, and Luduena and Hoppe[2–4] have studied the local anesthetic and toxicologic properties of these acids. The addition of a 2-butoxy group to procaine gives a compound, Sympocaine.*

This new local anesthetic is as active as tetracaine (Pontocaine) in producing sciatic nerve block (guinea pigs) and it is only one fourth as irritating (rabbits). Sympocaine is 20 times more active than procaine in producing sciatic nerve block (guinea pigs) or spinal anesthesia (rabbits).

Sympocaine has considerable activity by topical application and this suggested its use for topical anesthesia in the eye. A preliminary report on the use of Sympocaine in spinal anesthesia has appeared.[5]

CHEMICAL AND PHYSICAL PROPERTIES



Sympocaine

2 diethylaminoethyl 4-amino-2-butoxybenzoate hydrochloride.

$C_{17}H_{28}N_2O_3 \cdot HCl$ Mol. Wt. 344.9

Sympocaine is a white crystalline powder soluble in water to the extent of at least 20 percent. A 1.0-percent aqueous solution has a pH of 4.6 and no precipitation occurs when such a solution is adjusted to a pH of 7.0 with N/10 sodium hydroxide.[1]

* Sympocaine (brand of ambutoxate) hydrochloride 0.75 percent, WIN 3706, Winthrop Laboratories, New York 18, New York.

TOPICAL ANESTHESIA STUDIES IN RABBITS

The comparative topical anesthetic activities of Sympocaine and cocaine have been studied by the rabbit corneal irrigation technique.[2] Aqueous solutions ranging in concentration of Sympocaine from 0.03 to 1.0 percent were used, the appropriate solution of Sympocaine being applied to one eye of a rabbit while the other eye served as the control. The corneal reflex was tested by touching the eye with a blunt glass rod at five-minute intervals, with the absence of corneal reflex indicating anesthesia.

The threshold concentration (corneal anesthesia lasting for five minutes) for Sympocaine was 0.03 as compared to 0.1 for cocaine hydrochloride. The duration of anesthesia for Sympocaine 0.03 averaged 4.4 minutes with a range of from one to 10 minutes. This experimental study indicated that Sympocaine is from two to five times more active than cocaine under these test conditions and produces anesthesia at a much lower concentration.

TOPICAL ANESTHESIA STUDIES

Pontocaine, which is the most commonly used topical anesthesia in the cul-de-sac of the human eye, may be irritating for a few seconds, as are most anesthetics. In the search for a local anesthetic without this irritation and with equal or superior anesthetic action to Pontocaine, Sympocaine has been tried as a substitute.

For approximately one year I have used Sympocaine (0.75 percent) topically in the cul-de-sac of the human eye in an attempt to compare its anesthetic qualities with those of Pontocaine (0.5 percent). Approximately 75 eyes have been tested: (1) By the application of a cotton wisp to the cornea at five-minute intervals, to determine the duration of anesthesia, (2) by using the tonometer applied to the cornea in routine testing for glaucoma, and (3) by removing foreign bodies from the cornea under its influence.

The results of this clinical testing with Sympocaine (0.75 percent) as the topical

anesthetic in the eye indicate the following:

a. Patients seldom complain of local irritation when Sympocaine is dropped into the cul-de-sac, as compared to almost universal complaint when Pontocaine (0.5 percent) is used.

b. Anesthesia with Sympocaine takes a few seconds which compares favorably with almost instantaneous anesthesia with Pontocaine.

c. The duration of anesthesia with Sympocaine for all practical clinical purposes is from 15 to 20 minutes which also compares favorably with Pontocaine.

d. In routine testing with the tonometer, one drop of Sympocaine instilled in the cul-de-sac twice at 10-second intervals permits placing the instrument on the cornea without discomfort to the patient. This also compares favorably with Pontocaine.

e. Using the tonometric procedure, foreign bodies could be as easily removed from the cornea with wipe, spud, or burr, under Sympocaine as under Pontocaine.

f. On several occasions foreign bodies partially buried in the conjunctiva were successfully removed without discomfort with the use of Sympocaine. This seemed worthy of note since it has been my experience that the anesthetic influences of Pontocaine over the conjunctiva is insufficient for the removal of foreign bodies.

g. Sympocaine instilled into the cul-de-sac caused no allergic reactions in the 75 eyes tested; with the use of Pontocaine I have had a small percentage of allergic responses.

Subcutaneous use of Sympocaine

Sympocaine (0.75 percent) was compared to Novocain (2.0 percent) in subcutaneous injections for minor surgery of the adnexa of the human eye, including the removal of chalazia, verrucae, subconjunctival cysts, melanotic tumors, and so forth. From 1.0 to 1.5 cc. of Sympocaine was injected subcutaneously in 25 such surgical procedures:

a. Sympocaine compares favorably with Novocain since, when injected subcutaneously, there is no local irritation.

b. Sympocaine compares favorably with Novocain in the onset of anesthesia. Testing by pinching the skin with forceps at one-minute intervals, showed anesthesia in three to five minutes.

c. Duration of anesthesia with Sympocaine was not satisfactorily tested. However, minor surgical procedures were accomplished within five to 15 minutes with adequate anesthesia and with no discomfort to the patient.

d. In the 25 surgical cases, no allergic reaction was noted, which certainly ranks Sympocaine above Novocain in my experience. However, the number of cases is too small to permit general conclusions.

Comment

In clinical comparison Sympocaine not only ranked favorably with Pontocaine but was definitely superior to it in lack of local irritation when dropped into the cul-de-sac of the eye. In the few cases tested, Sympocaine showed superior conjunctival anesthesia. Though the number of cases tested is not sufficient to make generalizations, Sympocaine appears to be relatively free from allergic responses.

Also Sympocaine appears clinically to be as effective subcutaneously as Novocain, at least in the manner tested, and it seems to elicit fewer allergic responses.

50 East 72nd Street (21).

Sympocaine (0.75 percent), Pontocaine (0.5 percent), and Novocain (2.0 percent) were supplied by the Medical Research Department, Winthrop Laboratories, New York.

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HAND FUNDUS CAMERA*

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The photographic technique in ophthalmology has advanced a great deal in recent years. With improved materials and techniques follow-up of fundus changes by photography should become a general routine practice.

The instruments on the market at present, however, do not always meet the requirement of busy practitioners and researchers.

A Zeiss-Nordenson's type of fundus camera or its modified type is not only expensive but also too big and heavy to carry around to examine bedridden patients or for home visits. Because of these inconveniences, a simple and handy fundus camera would be welcomed by eye specialists.

Recently, I have designed and constructed a hand camera which is convenient for taking pictures of the fundus. In this, the principle and mechanism are taken from an ordinary direct ophthalmoscope. It is a small compact outfit, containing a monoflex camera, an extra small electronic flashlamp, and a 16-mm. film roll. It is portable in size and in weight (550 gm.), easy and simple to handle with one hand (fig. 1).

PRINCIPLE AND STRUCTURE OF CAMERA

In direct ophthalmoscopy, the image of a patient's retina falls in the examiner's retina through a combined optical system of the patient's eye, the Lecos-lens-disc, and the examiner's eye. If a lens of short focal distance is substituted for the optical system of an examiner's eye, and a film for the examiner's retina, the image of the patient's fundus must be thrown on the film when the refractive power of the lens (main lens) and the film's position are properly adjusted (fig. 2-a) To achieve this goal, the following technical problems have to be solved.

1. *Light source* (fig. 3). In order to avoid blurring of an image, the light source for photography must emit a light as strong as possible and as quick as possible. For this purpose, a specially designed small xenon electronic flashlamp (1) (50 watts sec. in about 1/1,000 sec.) is found to be adequate. The lighting circuit of this lamp is made synchronous with the movement of the mirror (9) of the observing system which will be explained later. For the examination of the fundus, a small incandescent lamp (2) is used as a source of light in focusing a desired picture. A transparent glass plate (3) is placed in front of the electronic lamp

Fig. 1 (Noyori). The hand fundus camera.

* From the Juntendo University Medical School, Bunkyoku, Tokyo.

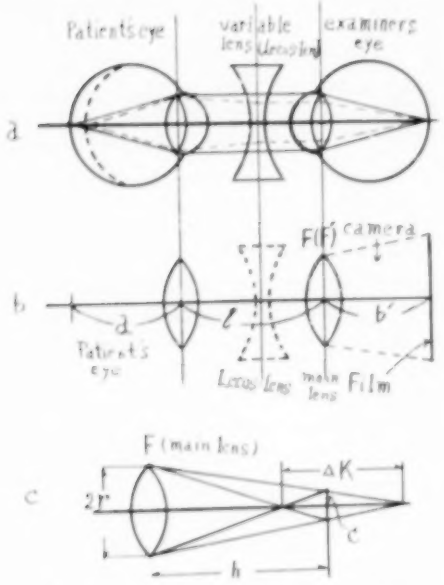

Fig. 2 (Noyori). Principle and structure of camera.

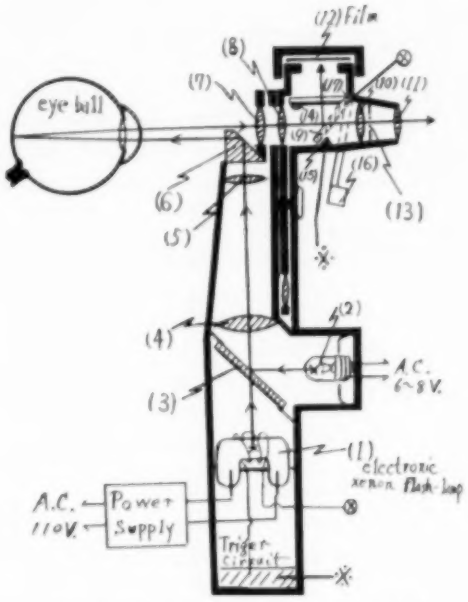

Fig. 3 (Noyori). Light source and optical system of camera.

at an angle of 45-degrees inclination so that the light ray from the pilot lamp will be reflected by this glass plate. The light thus reflected runs through the same optical system as the light from the flashlamp, and illuminates the fundus of the patient, through the condenser lenses. (4) (5).

2. *Optical system of camera* (fig. 3). As was mentioned above, the main lens (7) substituted for the optical system of the examiner's eye is placed in front of the Lecos-lens-disc (8) and just above the prism of illuminating system (6). The refractive power of this lens is determined in accordance with the method of focal adjustment and the size of image on the film.

The following relationship between the focal distance and the depth of the main lens attached to this camera is obtained from geomtric optic calculations (fig. 2-b).

$$dD \leq \frac{2hcr\ [(1-F'l)B+F']^2}{(r^2-c^2)\ (1-lB)}$$

where

dD: focal depth of the main lens

h: distance between the image and the main lens: h=l/F'

r: effective half diameter of the lens

c: diameter of the diffusion circle on the film (c must be smaller than the resolving power of the film to get a clear image. $c \leq 1/40$ mm.) (fig. 2-c)

F': refractive power of the main lens

l: distance from the patient's principal point to the main lens

B: refractive error of the patient's eye in dptr. (positive value in myopia)

The curves shown in Figure 4 are graphics of the above formula. These curves clearly show that the stronger the refractive power of the main lens, the deeper is its focal depth. So, if the focal depth is deep enough, it would require fewer lenses in the Lecos-disc. Since the adjustment is made only by this Lecos-disc, the process of focal adjustment would be much simpler. But, it must be taken into consideration that the refractive power of the main lens is inversely proportional to the size of the image on the film. Therefore, the image on the film would become too small if the refractive power of the lens is too strong. The follow-

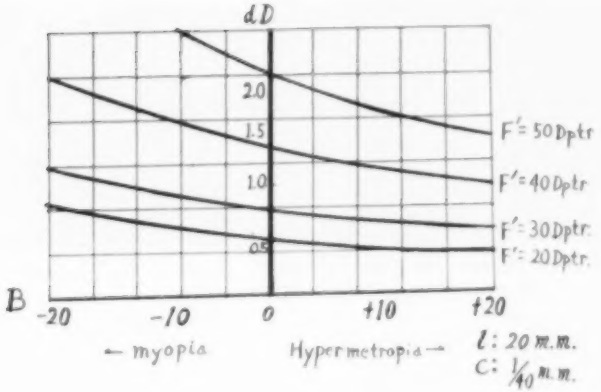

Fig. 4 (Noyori). Graph of geometric optic calculations.

ing formula shows the rate of magnification M.

$$M = D/nF' \ (/B - 1)$$

where

D: total refractive power of patient's eye
n: refractive index of the Listing's reduced eye

In practice, the image of the optic disc should be taken so that it shows on the film at least one mm. in diameter.

The refractive power of the main lens is fixed to about 30 diopters, so that it brings about a well-conformed relationship between the focal depth of the main lens and the magnification of the image on the film. This 30-diopter lens allows the difference of 0.5 diopter of refractive power of each Lecos-lens, and gives on the film an image of the optic disc about two mm. in size in emmetropia.

3. *Methods of focal adjustment* (fig. 3). The focal adjustment is made just as it is done with a direct ophthalmoscope. For the aforementioned reason, the Lecos-disc used in this case is a modified one, in which (each lens) is fixed with a difference of 0.5 diopter. The film (12) is placed horizontally in the roof of the camera, behind and upward of the Lecos-disc. The light ray from the patient's retina is reflected by the mirror (9) which is also placed behind the Lecos-disc at an angle of 45 degrees to the optic axis of the lens. This throws a clear image on the film. The mirror is movable by a lever (16) between 0 degrees (horizontal) and 45 degrees around a horizontal axis. The lighting circuit of the flashlamp is closed when the mirror takes exactly the position of 45 degrees. A cross-line (13) is placed so that it becomes symmetric to the film when the mirror achieves at the position of 45 degrees. The finder lens (10, 11) is placed behind this cross-line so that the cross-line can be seen clearly by an examiner. Focal adjustment is made by turning the Lecos-disc. By this method, both the cross-line and the image of the fundus of the patient must be seen clearly at the same time by the examiner. Thus the influence of the accommodation of examiner's eye is eliminated.

Fundus recording

The measurement of refraction should be made previously on the patient. His pupil should be kept dilated, as in the case of photography with a larger size fundus camera. The patient's fundus is seen through the eyepiece of the camera. Adjustment is made by turning the Lecos-disc as is done in direct ophthalmoscopy. The examination will be done more easily if the Lecos-disc is previously adjusted to the patient's refractive error. The cross-line and the patient's fundus must be seen clearly and simultaneously in this way. When this is done, a photograph can be taken by pushing the lever

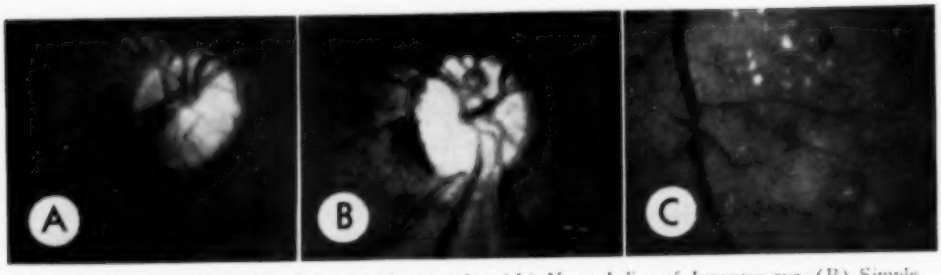

Fig. 5 (Noyori). Examples of fundus photography. (A) Normal disc of Japanese eye. (B) Simple atrophy of optic nerve. (C) Retinal hemorrhage and white spots.

(16) which is connected with the mirror (9). By pushing the lever, shifting of the mirror from horizontal to 45-degree position, closing of the light circuit, and lighting of the flashlamp can be done all at once; (14) and (15) are the connecting points of the flashlamp circuit. The photographs thus taken are shown in Figure 5.

No patients have ever complained of glare or pain during the procedure, and no harmful effects have ever been found.

Usually it is difficult to eliminate disturbing reflection from the patient's cornea when a large size fundus camera is used. But, with my camera, hardly any such trouble is encountered, and it can be used almost as easily and simply as an ordinary direct ophthalmoscope is used and provides pictures of the fundus with no corneal reflection, as shown in Figure 5.

The aperture ratio of this camera is about *f1:7*. An adequate exposure is obtained in a Japanese with color or black and white films of the sensitivity of A.S.A. 30. I regret that I cannot insert color pictures in this article. I have made a flashlamp of 100 watts sec. which will enable one to take pictures with a smaller diaphragm and various filters. This latter flashlamp will be incorporated in the production model of the camera.

SUMMARY

1. A new portable fundus camera is reported, in which the principle of direct ophthalmoscopy is utilized and to which a monoflex camera is attached. The light source is an electronic flashlamp, and the film a 16-mm. roll.

2. With this camera, photographic pictures of the fundus can be taken very easily and satisfactorily with one hand.

3. It answers the need of ophthalmologists in their practice and research study of the fundus.

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Thanks are due to Prof. T. Sato and Assistant Prof. A. Nakajima, of Juntendo University Medical School, Tokyo, for their kind assistance in my work.

AN UNUSUAL CASE OF AN INTRAOCULAR FOREIGN BODY*

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Boston, Massachusetts

The incidence of a foreign body being retained with the eyeball is not common. Outside the large centers of industry which employ metals in production, it is extremely low, while in areas of concentrated metallurgic use the occurrence of such an injury is about one in every thousand eye accidents.† Without question, however, is the seriousness of such an accident when a foreign body does become lodged within the eyeball; not only does it frequently cause considerable mechanical damage in its passage through the

* Presented before the New England Ophthalmological Society at Boston, November 16, 1955.

† Duke-Elder, W. S.: Textbook of Ophthalmology. St. Louis, Mosby, 1954, v. 6, pp. 6152-6156.

ocular tissues but the introduction of infection and the possibility of producing sympathetic ophthalmia are hazards always to be considered. In addition, the chemical changes set up by certain metals in their reaction with the ocular tissues may, if neglected, cause slow but progressive loss of vision. It is, therefore, prudent to consider every intraocular foreign body, whether of very minute size or whether the eye is relatively valueless from the point of view of function, as potentially serious.

It is obvious that the clinical effects produced by a foreign body are largely determined by the velocity with which it is traveling and the particular course it traverses within the globe. A large foreign body striking the eye at high speed will often completely and forcibly destroy it, and the only therapy possible is enucleation. Such an injury would be that occurring as a result of a direct hit by a golf ball or a bullet, for example, or by missiles encountered in wartime.

On the other hand, small foreign bodies traveling at high speeds and having sharp edges may penetrate the eyeball, leaving its outer coating relatively intact and traversing the inner structures according to the chance of direction and velocity. If the latter happens to be sufficiently great, the foreign particle may penetrate opposite coatings of the globe and come to rest in the orbital tissue. In the greater proportion of cases, however, most of the velocity is expended in penetrating one coat of the globe and the foreign body becomes lodged somewhere within the globe.

Statistically, iron and steel comprise by far the greater number foreign bodies causing injuries whether it be in industry or war. In recent years, however, the use of alloys in industry has become more prevalent, and steel is being combined with such things as tungsten, nickel, manganese, tantalum, chromium, cobalt, and other substances. Each one of these combined metals provides an individual problem in its removal. Copper, bronze, and brass may be encountered with lead from bullets. Occasionally zinc and aluminum, and rarely pieces of stone, rock, coal, sand, or even bone find their way into the eye.

Most important clinically, of course, is the magnetic property of the foreign substance, since upon this feature largely depends its facility of removal. In the past, over 90 percent of metallic foreign bodies seen in industrial centers were iron and steel which are of course magnetic. However, in recent years, more and more alloys are being employed in industry, each with specific properties and, therefore, the incidence of nonferrous, nonmagnetic foreign bodies is increasing. Today, different types of steel differ greatly in their magnetic property; for example, stainless steel requires a magnetic pull 30 times that of carbon steel.

Occasionally, a foreign body remains quietly impacted in the tissues of the lens, vitreous, or retina, remaining there for many years with the eye quiescently tolerating it. It is more likely, however, that progressive degenerative changes will occur, frequently accompanied by a low-grade persistent uveitis, with lens changes and anterior-segment inflammation which go on to retinal detachment and shrinkage of the globe. Early removal of the foreign particle is therefore most necessary and desirable.

Moreover, it is not uncommon for a particle to traverse the anterior segment and the vitreous, to ricochet once or twice from the retina and eventually either to become lodged in the retina or to fall spent to the bottom of the vitreous chamber. This phenomenon of rebounding from the posterior wall of the eye is not uncommon and was first demonstrated by Berlin in 1867.

Such passage through the vitreous may first appear clinically as a gray line with bubbles of air which, although absorbing rapidly, may be seen ophthalmoscopically as small, sharply defined spheres with bright centers and dark rims. These spheres were first thought to be blood but later several observers correctly interpreted them as air bubbles. The path of

the foreign body may also be outlined by small hemorrhages which become organized into fibrous bands and, if they are of any size, their shrinkage and the formation of traction bands may result in detachment of the retina or disorganization and atrophy of the eyeball. Although all degrees of damage may occur as a result of penetrating wounds, in the majority of cases, the harm which may befall an eye is both substantial and of serious consequence.

Case report

D. B., a 33-year-old white man, a laborer, was admitted to the Massachusetts Eye and Ear Infirmary about 9:00 p.m. on January 18, 1954, complaining of pain and blurred vision in the left eye. Around 4:00 p.m. on the same day, while carrying on his occupation, he had been reaching upward and was striking a steel bracket with a hammer when he experienced the sensation of a foreign substance entering his left eye. He suffered immediate pain with blurred vision and was transported to a local physician who referred him to this hospital.

At the time of admission, vision in the right eye was 20/20; in the left eye, 20/50. The external and internal parts of the right eye were entirely normal.

In the left eye there was moderate mixed congestion with rather pronounced circumcorneal congestion inferiorly. At the 5-o'clock position at the limbus, there was a ragged laceration just within the limbal boundary, and there was some blood upon the posterior corneal surface. There was a moderate flare in the anterior chamber which was formed and full, and many red blood cells were seen in the lower portion of the chamber; the pupil was dilated about six mm. There was some question as to whether a foreign body could be made out lying upon the ciliary body at the 6-o'clock position and surrounded by a small amount of blood. The disc, retinal vascular system, and the macular area appeared normal, although the vitreous was hazy.

The patient was immediately sent to the X-ray department and, although the regular personnel were not present at that hour, an X-ray film of the left eye and orbit was taken as soon as possible. Reading of the wet plates revealed a small intraocular foreign body but localization was not possible. Nevertheless, the patient was taken to the operating room and placed before the large magnet where several unsuccessful attempts were made to withdraw the foreign body to a more anterior position. No iris bulge nor pain reaction was produced. It seemed advisable to postpone further attempts until accurate localization of the foreign body could be obtained.

On the following morning, the foreign body, 2.0 mm. by 1.0 mm. by 2.0 mm., was localized at a point 11 mm. below the horizontal plane of the cornea, six mm. to the temporal side and 23 mm. back of the center of the cornea. The X-ray department thought the retina might be the point of localization.

The patient was again placed before the magnet. Repeated and determined efforts, however, produced no pain reaction or iris bulge.

Examination of the fundus by the direct method revealed some vitreous hemorrhage but no foreign body was visualized. The patient was then examined by the Retina Service to aid in localization. They believed that the foreign body had penetrated the posterior retina and choroid and had produced a moderate amount of vitreous hemorrhage.

Additional unsuccessful attempts to withdraw the foreign body anteriorly were made. Since three successive daily X-ray localizations of the foreign body seemed to indicate that it was lodged in the retina and because previous attempts to remove it by the anterior route were unfruitful, an attempt was made to withdraw it by the posterior route.

On the next day, following the usual preparation and anesthesia, a peritomy flap was made approximately five mm. from the limbus from the 1-o'clock to the 6-o'clock position. The tendon of the lateral rectus muscle was located, a 4-0 chromic catgut suture was

placed through the tendon, and the muscle was severed from the globe.

A traction suture was placed through the stump of the lateral rectus, and the eye was rotated nasally in an attempt to determine the exact position for penetration of the sclera. Upon doing this, a small dark rent was seen in the sclera near the point of X-ray localization; a few mm. posterior to this was a small, elevated dome of tissue, probably episclera. It seemed probable that the foreign body had passed through the sclera posteriorly and was lodged on its external surface.

Several diathermy points were placed around the small break, and a hand magnet was introduced in this area. Upon turning on the current, a definite click was heard and a small metallic foreign body became immediately adherent to the magnet, having been drawn from the adjacent area.

The lateral rectus muscle was then sutured in its proper position, and the conjunctiva was closed with 5-0 plain catgut suture. Antiseptic ointment and a double eye bandage were applied. The patient made an uneventful convalescence and was discharged from the hospital on the sixth postoperative day without complication.

He was next seen in the out-patient department eight days later. At that time vision in the left eye was 20/40, the corneal wound was well healed, the anterior chamber was of normal depth, the lens was perfectly clear, and there was some beginning retinitis proliferans in the inferior temporal quadrant below the macula. The entire retina was in normal position.

One month later the left eye showed no congestion and vision was 20/40. There was a sharply bordered area of edema and hemorrhage in the inferior temporal quadrant with some retinitis proliferans. No break in the retina was visualized. Two months later vision was 20/25-3 in the left eye, the anterior wound was well healed, and the lens was clear. There was considerably more pigment deposit in the previously edematous area in the lower temporal quadrant, and the proliferans was becoming whiter in appearance. No separation of the retina was present, but a scotoma corresponding to the fundus lesion was present.

Six months following the injury, vision in the left eye was 20/20-3; the retina was entirely attached, and, in the lower temporal quadrant, there still remained a whitish area with pigment deposit adjacent to the strand of retinitis proliferans. The patient was requested to appear at six-month intervals since that time but has not kept the appointments.

Comment

This case demonstrates that a metallic foreign body traveling at a tremendous speed can penetrate the outer coating of the eyeball, pass downward at an obtuse angle, avoid the lens, ricochet off the inferior retina, and pass backward, penetrating the retina, choroid, and posterior sclera, and become lodged upon the external surface of the sclera. In this case, a small amount of anterior chamber hemorrhage and moderate vitreous hemorrhage resulted and persisted in the form of organized strands of proliferans which, fortunately, were below the macula and did not interfere greatly with vision.

Following determined efforts to remove this foreign body by the anterior route, it became obvious that repeated magnetic attempts would be of no avail and successful removal was performed as described. It was then quite apparent why the attempts were consistently unsuccessful.

At no time was there the slightest evidence of infection; no corneal opacity of any significance, no lens opacity, and only slight disturbance of central vision. Such a case stands out in sharp contrast to what frequently occurs following this type of injury when perforating wounds of the cornea, iris prolapse, traumatic cataract, vitreous hemorrhage or infection, and probable retinal separation are frequently encountered.

520 Commonwealth Avenue.

BILATERAL INTRAOCULAR FOREIGN BODIES

Report of a case

John J. Gager, M.D., and
Merrill Grayson, M.D.
New London, Connecticut

The following case is reported because the injury seems to be an unusual one in civilian practice.

Case history

P. Z., a 34-year-old white man, presented himself at the office on July 13, 1955, with a history of some dirt having entered his left eye while he was using a hammer and cold chisel on his child's wagon. He had struck the chisel a single blow with the hammer. He suggested that the right eye, too, be washed out because some dirt may have entered that eye as well. The patient felt that his injury was of a very minor nature. He had experienced no pain and had no complaints except of slightly blurred vision and of a small red spot on the left globe.

On examination, the patient was found to have 20/40 vision in the right eye, and 20/30 vision in the left eye. There was an obvious perforation of the right cornea about two mm. below and nasal to the corneal apex. There was a small opacity in the right lens directly beneath this corneal perforation. A metallic-appearing foreign body about 1.5 mm. in diameter could be seen in the posterior lens cortex. The vitreous and retina in the right eye appeared normal. In the left eye there was a subconjunctival hemorrhage, four mm. in diameter, centering two mm. from the limbus at the 8-o'clock position. In the center of this subconjunctival hemorrhage there was a conjunctival laceration, three mm. in length. The left lens was clear.

On ophthalmoscopic examination, a metallic-appearing foreign body was seen imbedded in the left retina, about three disc diameters from the disc, in the 8-o'clock meridian. The foreign body appeared to be about three mm. in diameter. This foreign body was located in the center of a retinal hemorrhage, about one disc diameter in diameter, and appeared to be well imbedded in the retina with its sharp edge protruding into the vitreous.

With considerable difficulty, the patient was persuaded that he had a serious injury, requiring hospitalization, and was admitted to the Lawrence Memorial Hospital. X-ray examination showed a radiopaque foreign body about three mm. in size in the right eye. A similar slightly smaller foreign body was noted in the left eye. A general physical examination was negative except for the eye findings. The family history and past history were noncontributory.

The patient was operated under local anesthesia on the day of admission. The foreign body in the right lens was drawn into the anterior chamber with a magnet without difficulty and was deposited on the anterior iris surface in the 2-o'clock meridian near the chamber angle. From this position the foreign body was easily removed through a keratome incision at the limbus. The keratome incision was closed with 6-0 black silk on a Grieshaber needle.

The foreign body in the left eye was removed in the following manner: The sclera was exposed through a conjunctival incision in the lower nasal quadrant, 10 mm. from the limbus. The scleral lamellae were incised down to the choroid in a four-mm. radial incision. Silk sutures (6-0) were placed in the lips of the incision. The magnet was applied to the exposed choroidal surface, and the foreign body was extracted on the first attempt. The sutures were tied, and surface diathermy was applied to the area immediately surrounding the incision. The conjunctiva was closed with 6-0 black silk.

The patient's postoperative course was completely uneventful, and he was discharged from the hospital on July 30, 1955.

Since his discharge from the hospital, the patient's course has continued to be uneventful. The lenticular opacity in the right eye

has remained small. The left eye has shown no evidence of injury except for the conjunctival scar and a healing chorioretinitis in the area to which diathermy was applied. When he was last seen on September 20, 1955, the patient's unaided vision was 20/30 in the right eye, and 20/20 in the left eye.

154 Broad Street.

DIRECT OPHTHALMOSCOPY WITHOUT REFLEXES*

And an experimental model of a photographic ophthalmoscope

Manuel López-Enríquez, M.D.
Madrid, Spain

In April, 1953, at a meeting on optical problems of vision I presented a preliminary report on a procedure for direct ophthalmoscopy which eliminates the reflexes. Its application in photoretinography was also mentioned.

Elimination of reflexes has been studied since the time of Helmholtz. The names of such distinguished ophthalmologists as Ulrich, Bagneris, Czermack, Fuchs, Thorner, Wolff, Dimmer, and Gullstrand may be remembered in this connection. Their work made possible reflex-free ophthalmoscopy. However, the different procedures refer almost exclusively to the inverse image type. No known method of direct ophthalmoscopy allows fundus photography.

Considering the usual manner in which ophthalmoscopy and photoretinography are performed this work will use the terms already established, that is, direct and indirect according to the position of the object being presented to the objective of the camera.

In order to facilitate the understanding of my method, I shall review briefly how light is reflected by the surfaces of the eye. Consider two convex and one concave mirror, the former corresponding to the anterior surfaces of the cornea and lens and the latter to the posterior surface of the lens. These three mirrors produce the three classical images of Purkinje and obstruct exploration, making the fundus photography impossible. These images are formed at or near the optical axis and in a space limited by the pupillary plane and the plane of the posterior surface of the lens. Using the ordinary ophthalmoscope with a nonperforated mirror and at an inclination of 45 degrees, in relation to the emerging light, the axis of the light beam will run parallel to the optical axis of the eye being explored and therefore the observer (or the photographic objective lens) looking from above the mirror will meet the reflexes of the Purkinje images. If, however, an inclination of 50 degrees is given to the mirror, then, the axis of the emerging beam of light, instead of running parallel to the optical axis, will cross the optical axis at an angle of five degrees; the mirror will then act as a screen intercepting the perception of reflexes.

Figure 1 shows, for simplicity only, the tracing of the Purkinje images (i). The broken lines correspond to the tracing with the usual ophthalmoscope with the mirror at 45 degrees (E). The observer's eye at (O) (or the objective photographic lens) receives the reflexes interfering with photography. The continuous lines represent my solution to the problem by inclining the mirror (E′) at 50 degrees, in which manner the beam of light to enter the patient's eye (P) would have to become lowered or the mirror (E′) would have to be raised. In its new position the mirror (E′) would act as a screen for the reflexes, stopping their entrance into the observer's eye.

The experimental demonstration is easily carried out by substituting the mirror for a transparent film (for example, a cover slide) and watching the formation on it of the diffusion circles corresponding to the Purkinje images.

Following the procedure just described, I

* From the Institute of Optics, Daza de Valdes. (Director: Prof. José Ma. Otero Navascues.)

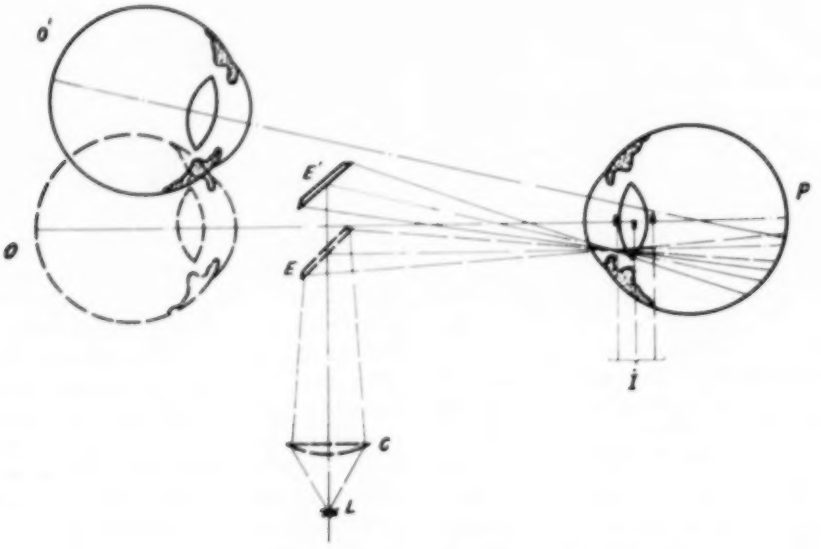

Fig. 1 (López-Enriquez). See text for explanation.

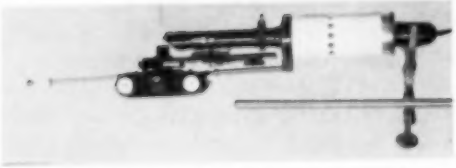

Fig. 2 (López-Enriquez). Photographic ophthalmoscope.

have built an experimental photographic ophthalmoscope, as seen in Figure 2. It is made of a refractive ophthalmoscope, carrying Rekoss and Couper equipment for fast and slow focusing and a small reflex camera connected to a Compur obturator.

Serrano, 93.

Ophthalmic Miniature

I am sorry to hear that your eyes are diseased. Take a little physic, and abstain from eating meat and butter for a few days. Wash them at the same time frequently with cold water. When the inflammation is a little reduced, wash them in a solution of a scruple of sugar of lead in a common-sized teacupful of water or green tea.

Benj. Rush, *Letter to James Rush*, November 25, 1803.

OPHTHALMIC RESEARCH

EDITED BY FRANK W. NEWELL, M.D.

Abstracts of papers to be presented before the Southern Section of the Association for Research in Ophthalmology, Washington, D.C., November 13, 1956

ALBERT E. MEISENBACH, JR., M.D., *Section Secretary*

Corneoscleral transplantations. Louis J. Girard, M.D., Don M. Smart, M.D., and Raymond L. Brewer, M.D., Houston, Texas.

To most ophthalmic surgeons who perform corneal surgery, the presence of severe scarring and vascularization of the cornea is considered a contraindication to penetrating keratoplasty. In view of the generally poor and disappointing results obtained when such a procedure is performed, improvement in methods of corneal transplantation have been sought. Because many of these eyes retain normal function in the posterior segment, it occurred to one of us (L. J. G.) that total corneal transplantation incorporating a rim of sclera might be effective. This procedure was tried in rabbits and performed on 10 otherwise hopelessly blind human eyes. A report of the experimental investigation, case reports of human eyes in which it was tried, and a motion picture demonstrating the technique are presented.

The effect of hydrochloric-acid injury to the cornea: II. Carbohydrate metabolism. Marion A. Guidry, Ph.D., James H. Allen, M.D., and Joyce B. Kelly, Department of Ophthalmology, Tulane University, New Orleans, Louisiana.

A uniform burning technique (splash method) was applied to the eyes of a New Zealand white rabbit to cause standardized hydrochloric-acid injuries to the cornea and conjunctiva. This was found to lower the pH of the corneal tissue to a value which is incompatible with native soluble corneal proteins. The pH quickly increased, however, to a constant value, slightly more alkaline than normal, within one-half hour.

The degree of hydration of the injured cornea did not change immediately. There was a gradual swelling, however, which reached a maximum value four to five days after onset of injury and returned to normal seven or eight days after injury.

Several metabolic functions of the cornea were investigated during the course of the burn. It was found that anaerobic glycolysis of this tissue was severely inhibited immediately after the injury and gradually recovered to a normal rate four or five days after onset of injury under the conditions of the experiment. Oxygen uptake was also severely inhibited. The recovery of oxygen uptake, however, did not begin for four or five days after injury and did not reach normal values until seven to eight days after onset of injury. Addition of substrates such as lactate, isocitrate, and succinate failed to increase significantly the oxygen uptake of the injured tissue. The possible significance of these findings is discussed.

Evaluation of research on effects of visual training on visual functions. Saul B. Sells, Ph.D., and Richard Fixott, Col. (MC) USAF, School of Aviation Medicine, USAF, Randolph Air Force Base, Texas.

Improvement of visual performance, as a result of learning, has been demon-

strated for foveal and peripheral visual acuity, visual thresholds, spatial judgments such as nearer, farther, visual extent, correction for illusions, estimation of areal size, angle, depth, distance, speed, and form. Learning effects have also been obtained for the recognition of patterned stimuli under what Gibson has termed "impoverished conditions" of stimulation, including peripheral presentation of stimuli, low illumination (night vision), and brief (tachistoscopic) presentation. No confirmed claims have appeared which would support the conclusion that refractive error or hue discrimination is affected by practice.

In the light of present knowledge, it may be accepted that visual functions which are narrowly limited by structural characteristics have not been modified by learning. However, perceptual learning occurs under many conditions. Improved skill in discrimination, learning to respond to "reduced cues" by associating fragmentary cues to stimuli, and improvement of skills through abstractive generalization may increase visual effectiveness without structural corrections of defects. The possibilities of utilizing training in visual skills as an aid to ophthalmology present challenging problems for further research and application.

Suggestions to Authors of Abstracts

Abstracts of papers presented to sectional meetings of the Association for Research in Ophthalmology and several other meetings of national interest are published in the Ophthalmic Research section of The American Journal of Ophthalmology. It is essential that these abstracts be prepared with care. The margin should be one and one-half inches on each side; manuscripts must be doubled or triple spaced. The abstract should be prepared so that it is ready for final publication. Time does not permit sending out proof.

Length of Abstract

The title should be descriptive and ordinarily should not exceed 10 words. Acknowledgments to workers or to grants-in-aid must follow the title. The author's name, institutional affiliation, and mailing address should follow the title. The text of the abstract should not exceed 600 words.

Content of Abstract

Each abstract should contain (1) a concise statement of the problem under investigation; (2) the experimental method used, which need not include details; (3) the essential results obtained. The text should include quantitative data from representative experiments or a summary of data. Tables or drawings cannot be accepted. References should be minimal and should be included in the text and not entered as footnotes.

Reprints

Reprints of single abstracts are not available. However, authors may order a reprint of the entire research section containing their abstract provided their order is submitted with the manuscript. Rates will be based on the number of pages in the Ophthalmic Research section in which the abstract appears.

It is suggested that authors consult a current issue of The American Journal of Ophthalmology for guidance in questions of form to be in accord with the editorial policies of The Journal.

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

MEMPHIS EYE EAR, NOSE, AND THROAT SOCIETY

DICUMAROL IN RETINITIS PIGMENTOSA

DR. JAMES E. WILSON said that when Mrs. J. E., a white woman, aged 41 years, was first seen on February 18, 1955, she said that she had been night blind for eight or 10 years. She stated that her breadth of vision had been failing for 10 or 12 years. She felt that central vision in the left eye had been failing for six years and that in the right eye for three years.

She had been under the care of an ophthalmologist in a nearby city who had established the diagnosis of retinitis pigmentosa and treated her with liver extract. His chart of her visual fields, made in 1948, showed for each eye, seven degrees up and temporal, 10 degrees down, and 15 degrees nasal. In 1952, her fields showed four degrees concentric around fixation for each eye. In 1954, her vision was: R.E., 20/40; L.E., 20/100, with a −1.0D. cyl. ax. 180°, O.U.

Family history. Her mother, grandmother, and great-grandmother had a condition in which their vision failed during the interval between the age of 35 and 45 years. They also exhibited night blindness and contraction of the visual fields during their visual failure. None of the male members of the family had poor vision.

Examination on February 18, 1955, showed: Vision, without glasses, was: R.E., 20/60, J12; L.E., 2/200, J0; with correction, −1.0D. cyl. ax. 180°, O.U., add +1.5D. sph., R.E., 20/25, J2, L.E., unimproved.

The cornea, irises, and ocular rotations were normal. The fundi showed typical bone corpuscle and other pigment scattered widely except immediately around the macula of the right eye and around the discs. The macula of the left eye showed some involvement. The vessels were thready, more pronounced in the arteries, and more in the left than the right eye. The disc of the right eye showed fair vascularity but that of the left eye was quite atrophic. There was a subcapsular opacity of the left lens below the center anteriorly.

Visual fields. On February 18, 1955, the fields taken with an 0.5-degree white target showed: R.E., 7.5 degrees concentric; L.E., 5.5 degrees concentric.

Treatment. The patient was treated with Dicumarol for four weeks, as recommended by Leo and Lidman in their paper published in THE AMERICAN JOURNAL OF OPHTHALMOLOGY (**39**:46 [Jan.] 1955). Briefly, the treatment was 300 mg. Dicumarol daily combined with Mephyton (Merck) in such dosage that the prothrombin time did not exceed 30 seconds.

A field examination on April 13, 1955, after treatment was the same as that taken before treatment. During the ensuing year, the patient has taken multiple vitamins and nicotinic acid with moderate regularity. Reexamination on January 31, 1956, showed the fundi and central vision to be the same and the visual fields an average of two to three degrees larger: R.E., 9.5 degrees concentric; L.E., 8.0 degrees concentric.

The results in this case are not so good as those reported by Leo and Lidman. Some of their patients showed improvement of five to 15 degrees.

CONGENITAL HEREDITARY OPHTHALMOPLEGIA

DR. PHILIP MERIWETHER LEWIS reported a father and two sons having congenital ptosis and almost complete ophthalmoplegia.

S. W. J., Sr., a white man, aged 29 years, was first seen in June, 1933, at the age of seven years. His eyes had always been defective. There was moderate ptosis of the right eye and marked ptosis of the left. Neither

eye could be elevated above the midline and downward movements were very limited. Outward movements were fairly good but inward movements were absent as was convergence. The left eye remained in a position of moderate divergence most of the time. In order to see he kept his head tilted backward and his chin up constantly.

Resection of the levator and about one half of the tarsus was performed in July, 1933. This equalized fairly well the ptosis of each eye. The refraction was +2.5D. cyl. ax. 90° in each eye. Corrected vision was 20/40, R.E., and 20/50, L.E. Further elevation of both lids by a frontalis operation would be helpful but he never consented to it.

S. W. J., II, aged six years, was first seen on August 13, 1955. His eyes were very similar to his father's, only worse. The ptosis was marked so that he carried his head tilted backward in order to see straight ahead. This was fairly effective for the left eye but not for the right, as most of the pupillary area of the cornea was covered by the upper lid. The right eye was in a moderately divergent position most of the time. There was no motion of either eye upward. The left eye could move down and out very slightly, the right not at all. At times both eyes diverged slightly. Convergence was absent. Refraction under atropine was: O.D., +3.0D. sph.; O.S., +2.0D. cyl. ax. 75°. Best vision was: O.D., 10/200; O.S., 20/70 and J3. The fundi and all other findings were normal.

The Friedenwald-Guyton operation was done on both upper lids under ether anesthesia. Frost sutures were placed in the lower lids for 48 hours. The postoperative appearance was very satisfactory.

D. J., aged five years, son of the patient in Case 1 and brother of the patient in Case 2 was seen at the same time as his brother on August 13, 1955. The findings were much the same as those of his father and brother, only worse. His headtilt backward was very marked. He had no motion up and none down. There was no movement of either eye in any direction and no convergence.

The same procedure for the correction of the ptosis was carried out as with his brother. While under ether, traction tests were done in the cardinal positions and no abnormality was discovered. The same was true with his brother.

Refraction under atropine was: O.D., +1.0D. sph. ⌒ +2.0D. cyl. ax. 105°; O.S., +3.0D. sph. Best vision was: O.D., 20/100; O.S., 20/200. Except for the muscle anomalies and the amblyopia the eyes were normal.

The correction of the ptosis was quite satisfactory by the Friedenwald-Guyton method in both brothers. It is interesting that the children's parents were cousins but their parents had normal eyes, as did their brothers and sisters. No other ocular anomalies were admitted by the families of either parent.

Bilateral congenital fibrosis

Dr. Alice R. Deutsch presented the case of L. W., a white girl, aged 11 years. The patient was seen for the first time in January, 1954. At this time she was sent by her teacher because her visual tests were unsatisfactory. She, herself, had no complaints. The mother gave the information that this girl was her only child; that she had had several attacks of malaria during this pregnancy but that the child was born at normal term with normal birth weight. There was nothing abnormal in her development except that she was two years old before she started walking. She had measles and chickenpox; both diseases were called mild cases. Otherwise she had always been healthy; her teeth needed careful supervision and most of her baby teeth had to be pulled. She was very short for her age and of stocky build. She did very well in school.

Examination revealed that both eyes were straight in primary position. Neither eye had any abduction; the adduction in both eyes was very reduced and jerky, but no retraction of the eyeballs or simultaneous narrowing of the lid fissures was present. Elevation and depression were in normal range. P.p.c.

could be brought to 15 cm. with effort. No abnormalities were visible in the anterior or posterior segments of either eyeball. With a −0.5D. sph. ⌒ +2.25D. cyl. ax. 90° she saw 20/30, J1 with her right eye; with her left eye she saw 20/40 and J2 with a −0.75D. sph. ⌒ +2.5D. cyl. ax. 80°. The visual fields were normal; she had no diplopia and apparently good fusion ability in her restricted field, which she used very well by turning her head. No nystagmus could be seen after the use of the Bárány chair. On the forced duction test the lateral recti did not give any response.

The possibility of a central nervous system involvement, like bilateral posterior internuclear paralysis or progressive nuclear paralysis, was considered not to be very probable because of the absence of induced nystagmus; because of the presence of normal facial muscles, a nuclear VII nerve agenesis was excluded.

It was thought that the child had a bilateral congenital fibrosis of the external recti with a secondary loss of elasticity of the internal recti (Duanesyndrome). Nevertheless a complete physical checkup was done, which was negative. A prescription for glasses was given her at this time.

She was not seen again until September, 1955. There was no change in the appearance or function of her eyes. It was surprising, however, that the mother who until two years ago had never noticed anything abnormal with the child's eyes, suddenly was very anxious to have something done to make her eyes move better. Because of the good primary position and the normal function in her restricted field, she was told that surgery really could not offer anything, and was not advisable.

Reaction to hyaluronidase

Dr. Charles King reported the case of G. H. W., a white man, aged 62 years, who was operated on June 1, 1954, for cataract, right eye.

Preoperative skin preparation was with Phisohex and irrigation with oxycamide of mercury and saline. Cocaine (four percent) was used as topical anesthesia. Retrobulbar and O'Brien injections of four-percent Novocain with 75 TBU of hyaluronidase were made in each area. A waiting period of 10 minutes produced good anesthesia.

A conjunctival flap and two preplaced McLean type sutures were used before the corneoscleral section was done with keratome and enlarged with scissors. After the eye had been opened, considerable edema and tenseness of the eyelids were noted. The speculum was removed and the lids opened with individual retractors. Iridectomy was done. The capsule was opened with a cystome and the nucleus almost "popped out" through the incision. Vitreous presented and the tenseness of the globe and lids seemed to be increased. Sutures were tied with difficulty. It was impossible to suture the conjunctiva, which was smoothed out with an iris spatula and the eye was closed. At this time Phisohex was suspected as being the allergen. In 48 hours all edema and swelling were gone and the eye looked like one on which an extracapsular extraction had been done.

The patient developed an allergic reaction to atropine in the following weeks. Needling was done on August 17, 1954, under cocaine anesthesia only. Corrected vision of 20/25 finally was achieved.

On January 4, 1955, the left eye was prepared for operation by scrubbing skin with Camay soap and irrigating with water. Retrobulbar and O'Brien injections of Novocain with hyaluronidase were made as before. In about 10 minutes proptosis of the eye was present; marked edema of the eyelids and left side of face was also present. The operation was deferred; the patient was placed on hydrocortisone (10 mg. every four hours). The next day edema of the right side of the face and eyelids was present, with the swelling extending below the chin. This reaction subsided in a few days.

Two weeks later a skin test with two percent Novocain was made with no allergic

response. An injection of 0.1 cc. of hyaluronidase solution was made into the skin of the opposite forearm. A violent edematous reaction with itching was noted in less than 20 minutes, the hard edema extending along the entire volar surface.

On February 8, 1955, the left eye was operated on without the use of hyaluronidase in the injections and no untoward reaction ensued. Convalescence was uneventful.

Dr. King has not read any similar report of adverse reaction to hyaluronidase. This drug in most instances is considered to be nontoxic in almost any concentration, but it is obvious that, occasionally, one will experience an undesirable response to its use.

ORBITAL PSEUDOTUMOR

DR. J. WESLEY MCKINNEY presented Mr. L. G., aged 60 years. The present illness began in October, 1955. At that time the right eye became red with some swelling of the lids but with no discharge or discomfort. He had had an intracapsular cataract extraction in this eye in 1951. The operation was followed by a plastic iritis. The inflammation persisted for several months and, except for the possibility of gout as revealed by an elevated blood urea, there were no other etiologic findings. A rather dense pupillary membrane was left.

At the present time, there was edema of the lids with some induration deep in the lower lid, limitation of ocular rotations in all directions, poor backward compressibility of the globe, intense congestion, and dilatation of veins over the bulbar conjunctiva and episclera. At first the fundus could be seen to be normal through a chink in the pupillary membrane and there was no evidence of intraocular inflammation. The fundus, however, had not been seen since miotics had been used. The tension was 35 mm. Hg (Schiøtz). The left eye showed incipient cataract. The tension in this eye was 27 mm. Hg (Schiøtz) and the fundus was normal. The ophthalmometer reading was 23 in the right eye and 18 in the left.

X-ray studies of sinuses and the orbital region have all been negative. The antrum was washed clear by Dr. Anthony. The only positive physical finding was a basal-metabolism rate of −17, for which thyroid extract was given. The tension was first controlled by Diamox but for the last month has remained between 36 and 46 mm. Hg despite DFP and Diamox, 250 mg. taken every six hours. He is presently being given Prednisolone. The ophthalmometer reading has remained about the same, that is 23 to 24 for the past three months.

The condition seems to be static and the patient, himself, has no discomfort. No treatment has altered the condition.

Eugene A. Vaccaro,
Recording Secretary.

AMERICAN JOURNAL OF OPHTHALMOLOGY

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NATIONAL COMMITTEE FOR RESEARCH IN OPHTHALMOLOGY AND BLINDNESS

After several years of study, experimentation, and difficulties, a new and permanent joint committee with the above title and officially representing the Association for Research in Ophthalmology, the Section on Ophthalmology of the A.M.A., the American Ophthalmological Society, and the American Academy of Ophthalmology and Otolaryngology has finally been established and will shortly begin to function.

The need for such a body came as the result of the rapid growth of available funds for ophthalmic research from various organizations, chiefly the United States government through the Institutes of Health, lack of co-ordinated knowledge of activities

in the fields of experimental research in ophthalmology and blindness, the urgent necessity for more trained workers, and the absence of a united official and ethical body to interpret these activities to the public, the universities, medical schools, the press, and, perhaps most important, to the governmental agencies that are concerned more and more with the field of medical research.

For a number of years, our colleagues in neurology have had such a committee called the National Committee for Research in Neurological Diseases (N.C.R.N.D.). Various independent lay groups have representation on this national committee and support its aims. These groups are the National Epilepsy League, Committee for the Understanding of Epilepsy, United Cerebral Palsy Association, the Muscular Dystrophy Association, National Sclerosis Society, National Society for Crippled Children and Adults, and the American Academy of Neurology. The N.C.R.N.D. has succeeded very well indeed in its primary purpose of promoting neurologic research in many ways. What is of equal importance is the fact that the ancillary lay organizations that had been going their own ways, often at cross purposes, have themselves benefited a lot by their active participation in the work of the national committee, without losing their separate identities or being disturbed or interfered with in their own work (fund raising, dissemination of information, public relations, and so forth). On the contrary, the neurologic national committee co-ordinates all activities and makes for a better understanding of the aims and functions of the component members.

Although the problems of neurologic research and of the ancillary groups that are involved are obviously different from those in our own field, yet the over-all philosophy is the same. It is for this reason that it is most gratifying to see our own committee finally established, first in ophthalmology and later with the active participation of the various lay organizations, both local and national, interested in the prevention of blindness and the care of the blind, some of which conceivably could be benefited by ophthalmic research.

The membership of our committee is indeed well selected and consists of men of experience, initiative, and what is of great importance, youthful vigor. The work of this committee is what they choose to make it and a broad vista of service to people and to ophthalmology opens up. If the success of the neurologic committee is any index, and it is certain that it is, then the success and unmeasurable value of the work of our own committee is assured. It is certain, too, that as the aims and purposes for which this committee is established are more widely understood, it will receive the active support of all ophthalmologists and many of the ancillary groups, which it duly deserves.

Derrick Vail.

THE OXFORD OPHTHALMOLOGICAL CONGRESS

The 41st annual meeting of the Oxford Ophthalmological Congress, July 2, 3, and 4, 1956, was, as usual, a delightfully stimulating three days of scientific presentations and social gatherings.

The proficient, genial Master, Sir Tudor Thomas, was installed into office by the gracious retiring Master, Frank W. Law.

The sessions were held in the admirably equipped university laboratory of physiology.

The meeting opened with a discussion on "Problems of lacrimal obstruction." Openers: Mr. L. P. Jameson Evans, Mr. R. C. Macbeth, and Mr. T. Keith Lyle.

Mr. Evans considered the etiology of the common forms of obstruction and their pathology. He reviewed the treatment and compared the results in children with those in adults.

Mr. Macbeth explained the rhinologists'

interest in nasal infections, sinus operations, and the anatomy of the individual patient. He described the Oxford Plan: a combination of operation by the ophthalmologist and the rhinologist, the latter makes the incisions and does the bone work. The technique was illustrated by means of diagrams and colored photographs.

Mr. Lyle spoke about the traumatic obstructions and lesions of the lower canaliculus and cited many practical points in the performance of correction operations.

In the discussion, Mr. W. H. Summerskill's remarks on syringing were direct, Mr. A. C. L. Houlton stressed local anesthetics, and Mr. B. W. Rycroft presented an especially accurate moving picture of a restorative operation.

Mr. R. Pitts Crick reported on the "Diagnostic conjunctival biopsy in sarcoidosis." He referred to the frequency of conjunctival involvement in generalized sarcoidosis and demonstrated the results of a series of biopsies.

Under the title "New aspects of the etiology of Sjøgren's syndrome," Dr. J. McLenachan based his remarks on 40 cases investigated clinically and biochemically. Liver dysfunction was found in the majority of cases and the significance of the changes was discussed in relation to the etiology.

Mr. F. W. Law's "Surgical treatment in simple glaucoma" provided no support to the essayist of last year who claimed that a greater field loss followed operation than drug treatment. This was not so in Law's series.

Dr. A. J. Bedell gave "An exposition of Kodachrome ophthalmoscopic photographs."

Mr. Rupert Parry, in a thoughtful, careful analysis of "Some principles in the surgery of retinal detachments," reviewed the procedures in vogue for its relief. Special mention was made of Lichtkoagulation of the retina, a new method of treatment developed by Meyer-Schwickerath. This was further explained by Mr. V. Purvis.

Mr. J. P. F. Lloyd and Dr. E. H. Leach, in "Experimental ocular hypertension in animals," described the effect of sanguinarine and citral and stated that both damaged the trabecula in monkeys, with the result that ocular tension became elevated but responded promptly to pilocarpine, eserine, or DFP.

"Biochemical changes in radiation cataract," by Mrs. A. Pirie, recorded carefully controlled ionized radiations which caused biochemical changes in the lens which preceded and accompanied the development of clinical lens opacities after exposure of the rabbit eye to X rays.

Dr. W. Jaeger talked about "Defective color vision caused by eye diseases"—chorioretinitis centralis serosa, hereditary optic atrophies, and methyl-alcohol poisoning.

A new method of securing corneal grafts in position by means of a splint was described under the title "Corneal graft fixation," by Mr. D. Ainslie.

The Doyne Memorial Lecture by Prof. Robert Platt, "A physician's thoughts on the retina," by combining facts gained from his long and fruitful experience with fundus photographs made this address on many phases of retinal vessel disease, including the effect of high blood pressure, an extremely valuable lecture. His excellent summary of the current concepts was authoritative and worthy of careful consideration.

Mr. A. C. L. Houlton's "The later stages of retrolental fibroplasia" included a report on the present condition of the patients reported at the meeting five years before. The conclusion seemed to be that treatment had little influence on the end-result.

The "Plastic lens insertion into anterior chamber" by Dr. J. Barraquer Moner showed the results in 35 personal cases. A beautiful moving picture provided a remarkably clear demonstration of how the plastic lens was inserted through a limbus incision to lie on the anterior surface of the iris. The eye shown tolerated the foreign body with minimum reaction. The author suggested that it would be worth while

in anisometropia, monocular aphakia, high myopia, and hypermetropia.

Mr. E. F. King gave a short historical review of "Scleral plication for retinal detachment," and suggested that infolding without removal of any of the scleral tissue was a simple procedure capable of more varied application than the usual resection, and giving more encouraging results in selected cases.

Mr. J. Minton's "Ocular manifestations of general disease" was a series of clinical experiences, retinal drawings, and photographs of the ocular manifestations of tuberculous meningitis.

In "Monocular proptosis," Mr. D. P. Choyce discussed several cases of displacement of the eye.

"Visual aids for the pathologic eye," by Mr. P. McG. Moffatt, Mr. D. Stenhouse Stewart, Mr. C. H. Keeler, and Mr. J. Pike was a unique assembling of ophthalmologic and optical specialists representing the best in co-operative efforts. Each opener, well qualified by experience, scientific training, interest, and ability, discussed the particular phase assigned to him and, as the result, the subject was completely explored and the limitations of the separate visual aids presented in detail. This valuable report must be read for it does not lend itself to an abstract.

Mr. F. A. Williamson-Noble's "Sidelights on refraction" referred to some personal experiences, including his own, with contact glasses.

"Some problems arising in a case of malignant melanoma of the choroid" was reported by Mr. O. Gayer Morgan. The diagnosis was confirmed after long study.

Mr. W. J. W. Ferguson closed the meeting with "Some clinical aspects on gonioscopy"—a comprehensive, well-received paper. He reviewed gonioscopic techniques, the appearance of various glaucomas, and iris involvements.

The many members who took part in discussions included Mr. Stallard, Mr. Tyrell, Professor Riddell, and Mr. Sawar. The Master frequently illuminatingly commented on a paper.

The garden party at Balliol College and the one at Osler House were very enjoyable affairs. At the annual dinner in the Hall of Balliol where the members and wives were present, Mr. Frederick Ridley welcomed the foreign guests in his inimitable fashion.

The meeting was effectively managed by the skillful, competent expert honorary secretary, Ian C. Fraser. There was at all times a pervading spirit of friendliness rarely experienced to the same degree elsewhere.

Arthur J. Bedell.

Ophthalmic Miniature

On Facilitating Vision

> Therefore we often wish the light to be changed, or the situation of those things we are looking at; and we either narrow or enlarge distances; and we do many things until our sight causes us to feel confidence in our judgment.
>
> Marcus Tullius Cicero: *On Ends.* Ca. 50 B.C.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular-motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

9

GLAUCOMA AND OCULAR TENSION

Kleinert, Heinz. **Pilocarpine-effortil ointment in the treatment of glaucoma.** Klin. Monatsbl. f. Augenh. **128**:401-410, 1956.

This ointment is a combination of 1-percent pilocarpine and effortil, an adrenaline-like compound. It was applied in the evening and proved to have a longer-lasting effect than 2-percent pilocarpine ointment in patients with chronic simple or secondary glaucoma. It is not indicated in closed-angle glaucoma. It was observed that the scleral rigidity increased during such treatment. Effortil has a lesser vasoconstrictive effect than adrenaline and this is of advantage in treating glaucoma where vasoconstriction may be a primary pathogenetic factor. (3 figures, 1 table, 5 references)

Frederick C. Blodi.

Leopold, I. H. and Carmichael, P. L. **Prolonged administration of Diamox in glaucoma.** Tr. Am. Acad. Ophth. **60**:210-214, March-April, 1956.

The authors describe the mode of action, short-term therapy, method administration, and dosage for long-term therapy. They use description of cases studied at Wills Hospital as examples, and point out reasons for failure. They found that Dimox can aid in the control of chronic glaucoma for more than six months and that failure encountered with such therapy will be due to intolerable side effects of the drug as well as its inability to reduce the tension. (4 tables, 12 references)

Theodore M. Shapira

Leydhecker, W. and Hussain, I. **Can provocative tests evaluate a glaucoma treatment?** Klin. Monatsbl. f. Augenh. **128**:479-483, 1956.

The water drinking test is not reliable for an evaluation of the efficacy of a method of treatment in glaucoma. However, it has prognostic value. If the test is positive, a decompensation of the glaucoma may be expected in the following three to six months if the treatment is not changed. (3 tables, 6 references)

Frederick C. Blodi.

Miller, S. J. **Iris bombé and the intermediate mesoderm in closed-angle glaucoma.** Brit. J. Ophth. **40**:248-249, April, 1956.

A single case is reported in which a peripheral iridectomy had been performed and inadvertantly only the anterior layer of the iris had been removed. This resulted in the ballooning forward of a black mass consisting of the pigment epithelium of the iris. A secondary operation was performed to complete the iridectomy. Since there is iris atrophy in most cases of glaucoma it is assumed that the integrity of the posterior layer is of vital importance; the anterior layer presents most of the atrophic changes. (1 figure, 14 references)

Lawrence L. Garner.

Mulberger, R. D. and McDonald, P. R. **The Stallard iridencleisis operation.** A.M.A. Arch. Ophth. **55**:676-680, May, 1956.

A modified iridencleisis is described in which a limbus-based scleral flap is made. A wedge-shaped peripheral iris flap is incarcerated in the wound after dialysing the ciliary body. The sphincter is left intact. The procedure has a high percentage of success and has the advantage of rapid reformation of the anterior chamber. (6 figures, 4 references) G. S. Tyner.

Nagdaseva, A. **The permeability of the eye vessels in glaucoma.** Vestnik oftal. **2**:333-36, March-April, 1956.

This study of the permeability of the blood vessels was done on 38 eyes of 21 glaucomatous patients. The control eyes were those of ten subjects with cataract and ten healthy persons. Sodium fluorescein was used for determining the permeability of the vessels. The patients took 100 cc. of a 2-percent solution of sodium fluorescein by mouth and the time of its appearance in the anterior chamber was observed. The fluorescein appeared first on the conjunctiva, about the vessels, then about iris vessels and finally in the aqueous. In the cataractous and healthy eyes it occurred usually from 40 to 50 minutes after ingestion. In glaucomatous eyes the fluorescein appeared in the eye, in from eight to ten minutes in 28 eyes with advanced glaucoma. In eyes with simple glaucoma, fluorescein appeared in the eye in from 20 to 30 minutes, thus the permeability of the blood vessels was markedly increased in advanced and decompensated glaucoma.

The basic substance, or hyaluronic acid, which fills in the intracellular space of the connective tissue of the blood vessel wall most likely plays an important role in the regulation of the vessel permeability. Hyaluronidase can increase the permeability of the vessels by destroying the hyaluronic acid.

In order to normalize the permeability of the vessels by an adequate stimulator, a preparation was made of the umbilical cord. It is a solution of non-protein substance of 0.25 cc. in 1 cc. of a solution of 18 percent of alcohol and which contains hyaluronic acid.

Its non-toxicity was first tried on rabbits. This preparation, named "Regenerator" was given subcutaneously daily; 1 cc. for five days and then every other day. The intraocular pressure, also the permeability of the vessels was lowered considerably. Thus this preparation can be recommended as an additional therapeutic measure in the control of glaucoma.

Olga Sitchevska.

Nemetz, U. R. **Acute glaucoma in intumescent cataract.** Klin. Monatsbl. f. Augenh. **128**:483-485, 1956.

During a ten-year period 11 patients were observed who had an acute attack of glaucoma in an eye that harbored an intumescent cataract. Seven of them had to be operated on because of glaucoma. In every instance the anterior chamber was shallow in the fellow eye. It is postulated that these cases represent not a secondary glaucoma, but a primary narrow-angle glaucoma, in which the intu-

mescent lens precipitates an attack. (6 references) Frederick C. Blodi.

Nemetz, U. R. **Clinical results of total iridectomy in acute glaucoma.** Arch. f. Ophth. **157**:407-411, 1956.

No new observations are recorded in the 218 cases which are reviewed. Four eyes were lost. (3 figures, 12 references) Ernst Schmerl.

Orlowski, Witold J. **Influence of side pressure on changes in visual field.** Klinika Oczna **25**:97-102, 1955.

The author observed the changes in the visual field under the influence of pressure with the ophthalmodynamometer. The increase of side pressure on the globe resulted in a gradual decrease of the peripheral field until it was limited only to the point of fixation and finally that would disappear. The author concludes that the changes in the visual fields in glaucoma depend on the relation between the intraocular pressure and the blood pressure. The mechanism of the loss of vision in glaucoma may resemble his experimental observation. (1 table, 13 references) Sylvan Brandon.

Phillips, Calbert I. **Sectoral distribution of goniosynechiae.** Brit. J. Ophth. **40**:129-135, March, 1956.

That goniosynechiae occur in closed-angle glaucoma is well accepted, but the distribution of these had not been reported. The observations reported here were the result of gonioscopic studies on every patient attending Glaucoma Clinic at the Institute of Ophthalmology and only those patients who had acute or chronic closed-angle or simple glaucoma were included in this study. The synechiae seen were recorded on a clock sector diagram. In simple glaucoma as well as in chronic closed-angle glaucoma the adhesions were found to appear at random whereas the adhesions in acute or subacute glaucoma were mainly above and a little to the temporal side. (4 figures, 1 table, 4 references) Morris Kaplan.

Phillips, Calbert I. **Closed-angle glaucoma. Significance of sectoral variations in angle depth.** Brit. J. Ophth. **40**:136-143, March, 1956.

Three case reports are presented to show that in the upper quadrants the chamber is more narrow normally and that in many eyes there is constant contact between the base of the iris and the cornea which can produce, with proper stimulation, prodromal signs and symptoms of glaucoma. The area of contact spreads downward with the years and with growth of the lens. In such eyes a peripheral iridectomy eliminates this ballooning forward of the iris by equalizing the aqueous pressure on both sides of the iris. (4 figures, 21 references) Morris Kaplan.

de Roetth, A., Jr. and Schwartz, H. **Aqueous humor dynamics in glaucoma.** A.M.A. Arch. Ophth. **55**:755-764, June, 1956.

Using the tonographic method of Grant, the authors studied the effect of hexamethonium and thiopental in cases of wide-angle glaucoma in order to help solve the controversy between the neurovascular and mechanistic theories of the cause of glaucoma. Their experiments indicate that in chronic simple glaucoma the central nervous system does have an influence on the dynamics of the aqueous humor. The hexamethonium caused a reduction of tension by bringing about a decrease in the flow of aqueous, whereas the intravenous injection of thiopental sodium, and other central nervous system depressants used as premedicating agents, lowered the pressure, apparently

by improvement in the facility of aqueous outflow. (7 tables, 40 references)
G. S. Tyner.

Shipman, J. S. and Luce, C. M. **Corneoscleral trephine operation.** A.M.A. Arch. Ophth. **55**:841-847, June, 1956.

The authors describe their technique and give reasons for favoring the corneoscleral trephine operation. They urge the use of a larger trephine blade in younger patients. The patients are kept in bed for five days. (17 figures) G. S. Tyner.

Trotter, Robert R. **Diamox: further reports on its use.** Tr. Am. Acad. Ophth. **60**:215-216, March-April, 1956.

The author reports the conditions under which the drug is used, the dosage, the experience encountered, the failures, and his belief in the value of long-term use of the drug. Theodore M. Shapira.

Velter, E. **Surgical treatment of infantile glaucoma.** Arch. chil. de oftal. **12**: 128-131, Aug.-Dec., 1955.

Surgical treatment is indicated when there is elevated ocular tension, progressive deepening of the anterior chamber and an increase in the volume of the globe. Vascular anomalies and disturbances of the iris always make the prognosis worse. Medical treatment is futile and operation must be done early but there is less agreement on the operation of choice. The author feels that infantile glaucoma presents a special problem because of the mesenchymal tissue in the angle and feels that goniotomy is the operation of choice. He discusses all types of glaucoma surgery and the reasons why they are not indicated in infantile glaucoma. At some future date we may be able to consider goniotomy as described by Barkan as the cure for infantile glaucoma. Walter Mayer.

Viallefont, H., Boudet, C. and Montagne, F. **The effects of remedial sleep on ocular tension.** Bull. et mém. Soc. franç. d'opht. **68**:458-466, May, 1955.

Remedial sleep seems to be similar, but more effective than psychotherapy, probably through inhibition of overstimulated cortical centers, however there may also be a peripheral action. Before taking this treatment the patients should be instructed on the purpose of the procedures. All the patients were kept asleep for six days. They were fed for noon and evening meals. Temperatures, pulse, diuresis and eliminations were checked. The retinal arterial pressure and the ocular tension were taken regularly. Miotics were not used during the sleeping periods. Contraindication of the remedial sleep treatment are cardio-vascular disease and disorders of the kidney and liver.

The case histories of seven patients with ocular hypertension are discussed. The results of the remedial sleep were in general favorable. The technical difficulties of this type of treatment are mentioned and are always taken into consideration. A strict, careful selection of cases is recommended, as only in the "reversible neurogenic stage of glaucoma" can remedial sleep give any promise of cure. (22 references)
Alice R. Deutsch.

Weekers, R., Watillon, M. and de Rudder, M. **Experimental and clinical investigations into the resistance to outflow of aqueous humour in normal subjects.** Brit. J. Ophth. **40**:225-233, April, 1956.

The factors that influence the resistance to outflow of aqueous in normal subjects were studied. Tonography was employed in vivo and perfusion experiments were used in vitro study. Freshly enucleated bovine eyes were used for the latter. The results confirm findings previously reported in that the resistance to outflow is increased by advancing years and is reduced by hyaluronidase. The latter could only be used experimentally

in the bovine eyes since a violent inflammatory reaction was noted when it was used in living eyes. Contraction of the ciliary muscle increased the facility of outflow, indicating a lowering of the resistance. A seeming increase of resistance is found as a function of the tonometric pressure exerted during tonography. The heavier weights showed greater resistance in patients with an elevated tension. (2 figures, 4 tables, 16 references)

Lawrence L. Garner.

Yamada, H. **Relation between macular capillary pressure and ocular tension.** Acta Soc. Ophth. Japan **60**:103-113, and 381-389, Feb., and May, 1956.

The increases in the macular capillary pressure and in the ocular tension which are produced by lowering the head are proportionate in normal eyes. After a cortical blocking, however, this parallelism of processes is lost. Yamada suggests that there are two ocular tension regulating centers, one in the cortex and the other in the midbrain. After conducting a similar experiment in glaucoma he concludes that a cortical disturbance is the main cause of glaucoma and a midbrain disturbance is supplementary to it. (3 figures, 9 tables, 87 references)

Yukihiko Mitsui.

10

CRYSTALLINE LENS

Georgariou, B. **The postoperative complications of senile cataract.** Arch. d'opht. **16**:169-176, 1956.

The author cites statistics on 7,209 cases of extraction of senile cataract at the ophthalmic clinic of the Faculty of Medicine of Athens, of which 90 to 95 percent were intracapsular. Some years ago postoperative panophthalmitis developed in 1 to 2 percent of cases, but between 1946 and 1953 there were only two cases, a percentage of 0.75 percent. Various reasons for this changed prognosis are listed, the prophylactic use of the sulfonamides and antibiotics being given top credit. Expulsive hemorrhage was noted in only one per one thousand cases, while postoperative hyphema, usually traumatic in origin occurred in 0.6 percent of cases. Iris prolapse was noted in 0.53 percent of cases with iridectomy, and in 3.5 percent of round pupil cases. Iritis occurred in 1.02 percent of the intracapsular cases and in 3.07 percent of the extracapsular cases. Postoperative glaucoma occurred in 1.48 percent of intracapsular cases and in 0.57 percent of extracapsular cases. Epithelization of the anterior chamber occurred in only two cases in the entire series. Secondary cataract occurred in 3 percent of 2,608 extracapsular cases. Detachment of the choroid occurred frequently but the prognosis was always good. Retinal detachment was the most serious complication, occurring more frequently in intracapsular cases. No figures were given of the frequency of retinal detachment, but 75 percent of the patients in which it occurred were healed by surgery.

Postoperative visual acuity was good in most cases and is analyzed in some detail. Postoperative astigmatism as noted on the twentieth postoperative day averaged 1.5 diopters but had dropped to 1.0 diopter three or four months later.

The author comments on the causes of the various complications and on ways of preventing them. P. Thygeson.

Kreibig, Wilhelm. **Treatment of lens luxation into the vitreous.** Klin. Monatsbl. f. Augenh. **128**:573-580, 1956.

The following procedure is advised: conjunctival flap, cataract section, total iridectomy. The surgeon then looks at the luxated lens through an ophthalmoscope and with the other hand pushes a loop behind it under visual control. The extraction follows. In eight cases this

operation proved to be successful. (10 references) Frederick C. Bodi.

Livant, Saul. **Bilateral indentation of cornea and lens.** A.M.A. Arch. Ophth. **55**:681-684, May, 1956.

This developmental anomaly is described in a 61-year-old patient. The visual acuity could be corrected to 20/30 with $-6.50 +11.00 \times 180$ in the right eye and to 20/70 with $-7.50 +11.00 \times 180$ in the left. (3 figures, 4 references)

G. S. Tyner.

Mitter, S. N. **Bilateral dislocation of the lens.** Brit. J. Ophth. **40**:253, April, 1956.

By bending his head forward, as in the act of washing the face, this patient was able to move his lenses to the anterior chamber and yet be comfortable. The lenses would slip back into the posterior chamber when he lay down. Aphakic glasses were worn and excellent or comfortable vision is reported. Over a period of three years no ill effects have occurred. No measurement of tension is recorded but because of his obvious comfort no attempt has been made to change the situation. (2 references)

Lawrence L. Garner.

Nicholls, John V. V. **Concurrence of macular edema with cataract extraction.** A.M.A. Arch. Ophth. **55**:595-604, May, 1956.

The author reports nine cases of macular edema following cataract extraction. He believes the condition is caused primarily by interference with the capillary vascular flow to the macula. Vasospasm caused by anxiety and hypertension is an important feature and should be treated by vasodilators and sedation. Vasospasm becomes an even more important factor in arterioles already narrowed by sclerosis. Other factors which may be of importance in precipitating macular edema are operative trauma, disturbance of the vitreous posteriorly and prolapse of vitreous anteriorly through the pupil. (1 table, 18 references)

G. S. Tyner.

Nordman, J., Mandel, P. and Schmitt, M. L. **Pathogenesis of alloxan cataract.** Bull. et mém. Soc. franç. d'opht. **68**:450-457, May, 1955.

White rats, four months old, were injected with 300 mg. of alloxan per kg. Insulin was given regularly except during the last two days before the examination. The lenses were checked eight days and three weeks after the alloxan injection. Fine punctate opacities could be seen in the lens after three weeks; after one week the lenses were still clear. The opacities in the lens seemed to be caused by a lack of available energy, due to modification in the enzymatic activity of the carbohydrate cycle, namely a restriction in the hexokinase activity (71 percent) and increased activity of the ATPase (83 percent). The failure in hexokinase impairs the phosphorilization of glucose. This is a fundamental process. The hyperactivity of ATPase favors the decomposition of adenosine-tri-phosphate and causes an imbalance and reduction of available energy, followed by a faulty distribution in amino acid arrangements. (4 figures) Alice R. Deutsch.

Patterson, John W. **Diabetic cataracts: a review of experimental studies.** Diabetes **5**:93-97, March-April, 1956.

The time required for diabetic cataract formation bears an inverse relationship to hyperglycemia (hyperbola equation). There is a minimum time required for cataract maturation and also a minimum blood sugar level, which is about 250 mg./cc. Cataract may be caused by the toxic effects of hyperglycemia, protein

destruction, essential metabolite loss in the urine, or by the failure to absorb glucose in the absence of insulin.

The administration of a high fat diet, phlorizin (to lower blood sugar levels) or fasting delays the formation of cataract. In galactose-fed rats with one carotid artery ligated, 90 percent of the cataracts are seen to occur first on the side with the better circulation.

In the absence of insulin, the uptake of glucose by the lens is impaired. Since the lens depends on glucose for a major portion of its energy, the total available energy is lowered beyond the critical point for maintaining transparency. The lens is also dependent on the constituents of the blood as alternate sources of energy. Normally these substances arise in other organs, notably the liver, and the amount in the blood is inadequate to supply the lens with energy. A decrease in available energy could produce cataracts by stopping the synthesis of glutathione, enzymes, proteins, or other structural compounds, or by blocking the maintenance of a water and electrolite balance. (6 figures, 50 references)

Irwin E. Gaynon.

Scheie, Harold G. **A method of cataract extraction following filtering operations for glaucoma.** A.M.A. Arch. Ophth. **55**: 818-829, June, 1956.

The author discusses the advantages and disadvantages of various procedures for removal of cataract following filtering operation for glaucoma. The author reports a method of peripendicular corneal incision superiorly which he has used in 22 eyes with good results. (13 figures, 1 table, 15 references) G. S. Tyner.

Wheeler, J. R. **Traumatic implantation cyst in anterior chamber after cataract extraction.** Brit. J. Ophth. **40**:245-247, April, 1956.

A case of implantation cyst was noted 23 months after an uneventful intracapsular extraction of the lens. A single corneoscleral suture had been used. During its removal this cyst ruptured and it was difficult to see its membrane. As much of it as could be seen was removed and the site of the base then touched with a pointed diathermy needle. Three weeks later one radon seed was sewed to the conjunctiva at the limbus. A dose of 4000 r at 0.5 cm. was given. Six months later no recurrence was visible, but there was a marked keratitis and loss of vision. (2 figures, 3 references)

Lawrence L. Garner.

11

RETINA AND VITREOUS

Arruga, H. **Retinal detachment: selection of the proper operation.** Arch. chil. de oftal. **12**:121-127, Aug.-Dec., 1955.

Some detachments are due to traction of the vitreous, others are due to exudation of the choroid and some other detachments to a combination of both of these causes. The author feels that the difficulty in judging the behavior of the choroid is responsible for many of the poor surgical results. The two main problems are when to operate and what type of operation to use.

In Gonin's time the operation was performed as soon as the retinal breaks had been localized. Later a certain delay in operating was believed to be beneficial because the retina settles down with rest and binocular bandage. However some of the detachments get worse with rest, and it is difficult to know when to operate.

In recent detachments in myopes with a small tear the author does surface coagulation. In recent detachments with multiple tears the author waits until the retina has settled as much as possible and then practices surface diathermy. However, if the retina does not flatten, he then looks for an infectious process

and treats the patient with antibiotics and corticosteroids for a maximum of 15 days and does a surface coagulation then. Should the operation fail, the author waits three weeks and does a scleral resection in a different area, then diathermy, as he feels that even at this time the diathermy many times may still be effective if the choroid is again brought into contact with the retina. In all detachments with extensive tears the author does a scleral resection above or immediately behind the tear. The author also routinely injects air into the vitreous in all his operations for detachment.

In cases of inferior disinsertion the author employs diathermy in the area where the retina is closest to the choroid, in order to prevent any extension of the detachment and protect the posterior pole. If the disinsertion is superior or lateral, he feels that an emergency procedure must be performed, and a barrage is the procedure of choice in order to protect the retina still in place.

When there is a macular hole the author takes off the lateral rectus muscle, applies light diathermy directly to the macular area, makes a puncture for drainage of the subretinal fluid, and injects air. These patients need to be kept in bed for a long time, sometimes for two months, as the subretinal fluid increases in density and settles in the inferior pole of the eye. Many patients who appeared hopeless immediately after operation can be substantially helped.

Where no tear can be located the author does a scleral resection over the area in which it appears clinically that the detachment may have started.

In long standing detachments, only if the retina settles with rest is there a fair prognosis; the improvement suggests that there is good choroidal function and then the author does a scleral resection or surface diathermy.

The first ophthalmoscopic examination is done no earlier than 15 days after the surgery. If the retina looks better, bed rest is continued. If the detachment seems unchanged, scleral resection is done in another quadrant. If the patient is worse than before the operation, the prognosis is bad, but if it is in an only eye a scleral resection should be done.

In recurrences two months after the first operation the author advises bed rest, and if the subretinal fluid does not reabsorb completely does scleral resection which may be in the area of the old diathermy. Scleral resection is the operation of choice in aphakia.

Walter Mayer.

Barsky, David. **Central retinal vein occlusion treated with anticoagulant and steroid therapy: case report and discussion.** Henry Ford Hosp. Bull. 4:98-101, June, 1956.

One case is reported and it is believed that the steroid therapy is essential.

Irwin E. Gaynon.

Bischler, Vera. **The multicolored (speckled) fundus. A "forme fruste" of Groenbald's and Strandberg's disease.** Bull. et mém Soc. franç. d'opht. 68:286-291, May, 1955.

The fundus lesion described consists of many very fine whitish-yellow or grayish-brown dots and spots which either cover the fundus evenly or are restricted to circumscribed areas. The pathologic basis of these dots is a thickening of the cuticular layer of Bruch's membrane with localized loss or accumulation of pigment (Bertha Klien). Similar lesions were seen and described in association and with angioid streaks and with or without systemic elastorrhexy. The differential diagnosis often was a problem and the term "speckled fundus" for this syndrome seems justified. Three cases were observed by the author. (1 figure, 36 references)

Alice R. Deutsch.

Charamis, I. **Surgical treatment of angiomatosis.** Bull. et mém. Soc. franç. d'opht. **68**:248-253, May, 1955.

The importance of early surgery, preferably diathermy coagulation of the angiomatous lesion, in angiomatosis of the retina is stressed. An essential point in the surgery is the use of a high-intensity current of 50 to 70 milliamp. in surface coagulation and a current of 40 to 50 milliamp. for the perforating electrodes of 2 to 2.5 mm. After destruction of the vascular nodule, the nutritive vessels should be destroyed also by exactly placed coagulation points. Among the three cases reviewed, favorable results were achieved in the two early ones (28 references) Alice R. Deutsch.

Davies, W. S. and Thumim, M. **Cavernous hemangioma of the optic disc and retina.** Tr. Am. Acad. Ophth. **60**:217-218, March-April, 1956.

The authors report a case in which it was necessary to differentiate clinically between tuberous sclerosis, hemangioma, and melanoma. Pathologic study revealed this tumor to be a very rare cavernous hemangioma, which is very rare in the retina and optic disc. (2 figures, 3 references) Theodore M. Shapira.

Dymitrowska, M. and Omulecka, D. **A case of arteriovenous aneurism of the retina.** Klinika Oczna **25**:141-144, 1955.

A case of arteriovenous aneurism of the retina in a 29-year-old woman is described. The right eye was blind since childhood. There were several vessels covering the posterior pole of the eye. There was evidence of aneurysm invading the right maxilla and visible on the hard palate. There were recurrent severe hemorrhages from the back of the oral cavity. Ligation of the external carotid artery ended the danger of hemorrhages. (3 figures, 12 references) Sylvan Brandon.

Fischer, Franz. **Therapy of diabetic retinopathy.** Arch. f. Ophth. **157**:495-505, 1956.

This well-integrated history of the therapy of diabetic retinopathy is based on a thorough review of the literature. The activity in this segment of ophthalmology made a critical and orderly consideration of the data desirable. The live contemporary questions are isolated and it is made clear that the trend in attitude toward therapy in diabetic retinopathy is prevention. (100 references)

F. H. Haessler.

Fison, James. **False position of the posterior pole as a fundus landmark.** Brit. J. Ophth. **40**:234-238, April, 1956.

Observation of fundi for over 40 years convinced the author of the variability of the position of the macula in relation to the center of the nerve head. Most commonly the lower border of the nerve head is on a level with the fovea. In its highest position the center of the nerve head lies slightly above the level of the fovea. In a vertical meridian the variation of the position of the fovea in relation to the center of the nerve head can be as much as one and one quarter disc diameters. The term posterior pole should not be used. (32 references) Lawrence L. Garner.

Glees, M. **Cilioretinal and opticociliary vessels as a finding of general diagnostic importance.** Klin. Monatsbl. f. Augenh. **128**:580-592, 1956.

Among eight patients with proved cerebral angioma, seven had a cilioretinal artery or an opticociliary vein. Three patients with an intracranial aneurysm showed similar vascular anomalies of the optic nerve head. This seems to indicate a certain connection between these two genetically related vascular systems. The presence of such vessels on the disc should encourage the neurologist to per-

form an angiography in a dubious case. (24 figures, 5 references)

Frederick C. Blodi.

Golding, A. M. B. **Retinitis punctata albescens with pigmentation.** Brit. J. Ophth. **40**:242-244, April, 1956.

A single case is described with a brief review of the essential findings in this condition. The unusual feature in this case is that the patient was symptom-free until the age of 18 years. (2 figures, 10 references)

Lawrence L. Garner.

Greenhouse, J. M. and Szewczyk, T. **Skin hemangioma and retrolental fibroplasia.** Arch. Dermat. & Syph. **73**:568-571, June, 1956.

An extensive hemangioma of the right side of the face occurred in a child who also had retrolental fibroplasia. The incidence of hemangioma is slightly greater in infants with retrolental fibroplasia than in those without it. There seems to be no relationship between the administration of oxygen and the development of hemangioma of the skin.

Irwin E. Gaynon.

Hellstroem, Bo. **Experimental approach to the pathogenesis of retrolental fibroplasia: the influence of oxygen concentration on the oxygen-induced changes in the mouse eye.** Acta paediat. **45**:295-308, May, 1956.

The influence of the concentration of oxygen on development of oxygen-induced changes in the eye was studied in 214 newborn mice. A concentration of 20 percent caused no histologically demonstrable changes and one of 40 percent caused few changes. With an increase of oxygen to concentrations greater than 50 percent the incidence of injury to the eye increases rapidly.

Irwin E. Gaynon.

vom Hofe, K. **Recurrent retinal detachments.** Klin. Monatsbl. f. Augenh. **128**: 557-561, 1956.

Among 573 operations done for retinal detachment during the last 7 years, there were 106 recurrences. These were divided into several groups. In 27 cases the tear was extensive and had not entirely closed. However, in 12 of these 27 an operation was successful. In 55 of the recurrences new tears appeared and here only 12 became reattached with another operation. Of 18 eyes which had to be operated on a third time only four were cured. (3 figures, 9 references)

Frederick C. Blodi.

Jayle, G. E. **Technique and surgical statistics of the wing sclerotomy.** Bull. et mém. Soc. franç. d'opht. **68**:342-349, May, 1955.

In this modification of the lamellar sclerectomy a thick wing-shaped scleral flap is made. The shortening of the sclera is accomplished by mattress sutures, inserted at the hinge of the flap and pulled through the limbal lip of the incision. A secondary anchorage of the floating scleral lid is necessary.

Twenty case histories are reviewed. There were 13 complete reattachments of the retina, four partial reattachments and three failures.

Alice R. Deutsch.

Kapuscinski, W. J. **The "pouls répulsif" in the dog. A motion-picture (analogy to the pouls répulsif of the human retina).** Bull. et mém. Soc. franç. d'opht. **68**:293-294, May, 1955.

The "pouls répulsif" could be demonstrated through especially prepared burr-holes on the surface of the brain in anesthetized dogs of medium size. A similar phenomenon could be shown on the femoral artery of the dog. The second phenomenon could be abolished whenever the paw of the dog was put under pressure anterior to the surgical incision.

In the human fundus the "pouls répulsif" is easily observed on binocular ophthalmoscopy and manifests itself by a rapid displacement of the artery in

systole and a slow return in diastole. It is a physiologic phenomenon, visible on the normal retina and disc and it is independant of the general arterial blood-pressure. It disappears early in papilledema but it does not disappear in papillitis. The differential-diagnostic importance and the mechanism of the "pouls répulsif" are discussed.

Alice R. Deutsch.

Klomp, G. **Results of 713 retinal detachment operations.** Klin. Monatsbl. f. Augenh. **128**:561-568, 1956.

Out of this number 429 patients were cured. In 89 instances repeated operations were necessary; 76 eyes in which no hole could be found were operated on and in this group 26 patients were cured. Only diathermy coagulation was used. In ten eyes a complete, circular barrage was done in one sitting. In 5 of these patients the retina became reattached. (7 tables, 12 references) Frederick C. Blodi.

Maggi Zavalia, J. and Zurbriggen, M. B. **Corneal hypesthesia following lamellar scleral resection for retinal detachment.** Arch. oftal. Buenos Aires **31**: 59-63, Feb., 1956.

The authors discuss a hitherto undescribed drawback of scleral-resection operations which may lead eventually to untoward complications. In eight patients submitted to a lamellar sclerectomy the corneal sensibility was investigated by means of rough clinical tests. In all of them a definite hypesthesia or anesthesia of that membrane was found to be present, either over its whole surface or in the quadrants corresponding to the resected area; in some the disturbance still persisted at the end of one year and in one it gave rise to a serious corneal ulcer. (17 references) A. Urrets-Zavalia, Jr.

Marin-Amat, M. **The present treatment of retinal detachment, amelioration of the prognosis.** Bull. et mém. Soc. franç. d'opht. **68**:276-286, May, 1955.

The author agrees that for recent and localized retinal detachment the classical methods are sufficient and that in older cases in which the retina does not flatten out on bed rest a reduction in the size of the scleral capusle is indicated. The scleral resections in their various modifications fulfill those requirements, especially in E. Meek's technique, a combination of the transverse and the anterio-posterior lamellar scleral resection. The chorio-scleral fold after scleral resection is thought to be a definite obstacle towards complete healing. A new method is described which consists of extensive and intensive diathermy coagulation to impair the secretory function of the choroid and to cause considerable shrinkage of the sclera with subsequent reattachment of the more or less inelastic retina. A previous drainage of the subretinal fluid is imperative. The specific advantages of this operation are its simplicity, the expected pronounced shrinkage of choroid and sclera and the avoidance of chorio-scleral folds. The technique is suggested only for cases previously thought inoperable. (11 references)

Alice R. Deutsch.

Melanovsku, W. H. and Kobuszowski, M. **Two cases of retrolental fibroplasia. A contribution to the pathogenesis of buphthalmos.** Bull. et mém. Soc. franç. d'opht. **68**:238, May, 1955.

Two eyeballs, removed because of retrolental fibroplasia and hydrophthalmos were examined. An aplasia of Schlemm's canal, a degeneration of the corneo-scleral trabeculae, and proliferation of the connective tissue with the formation of teleangiectatic capillaries were found as part of a possible generalized vascular dysplasia of the prematures.

Alice R. Deutsch.

Mercier, M. A. **Chlorpromazine and the retinopathy of prematures.** Bull. et mém. Soc. franç. d'opht. **68**:231-237, May, 1955.

Inhalation of pure oxygen, necessary in very high altitudes often produces pulmonary congestion in pilots. It was found that guinea pigs kept in metal containers and exposed to a high concentration of oxygen reacted similarly—but if these guinea pigs were given chlorpromazine, the lungs remained clear.

The preventive use of chlorpromazine and its possible effect on the retinopathy of prematures, following the use of oxygen, was investigated. Among 47 prematures who did not get chlorpromazine 9 showed signs and symptoms of retinopathy and among 30 infants who were given chlorpromazine 8 developed the disease. In the latter group the disease subsided in shorter time. A possible mode of action of chlorpromazine is a depression of the vasoconstrictor center. (2 figures, 24 references)

Alice R. Deutsch.

Nataf, R., Besnainou, R., Reynon, M. and Spaier. **Scleral resection in retinal detachment.** Bull. et mém. Soc. franç. d'opht. **68**:350-383, May, 1955.

The results in 59 cases of surgery for retinal detachment are interpreted. The patients were divided into three groups. The first group included eighteen patients not operated upon; those of the second group were operated on by diathermy coagulation and there were eight failures. In the third group the patients were subjected to lamellar scleral resection and diathermy coagulation as described by Paufique. This group is analyzed in detail. Indications for scleral resections were the generally accepted ones. Among the 23 eyes operated on there were nine failures, five of them in eyes with especially poor prognosis from the beginning. The authors emphasize that the technique of lamellar scleral resection is not more difficult than other eye surgery and that the resection can be repeated and extended around the whole circumference of the globe. This operation should be the first method of choice in certain types of retinal detachment and not the procedure of last resort. (4 figures, 3 tables) Alice R. Deutsch.

Nover, A. and Oehlert, W. **Pathogenesis of retinoblastoma.** Klin. Monatsbl. f. Augenh. **128**:549-557, 1956.

A two-year-old girl died from a unilateral retinoblastoma though enucleation, exenteration and irradiation were done. The autopsy revealed metastases in the brain, the bones, the lymph nodes, the liver and both ovaries. Cartilagenous exostoses were present below the knees and this speaks perhaps for a certain tendency for tumor formation. (4 figures, 24 references) Frederick C. Blodi.

Odic, R. and Nectoux, R. **Late results of retinal detachments, a social viewpoint.** Bull. et mém. Soc. franç. d'opht. **68**:394-399, May, 1955.

A statistical review of 310 patients with retinal detachment is presented. The cases were taken from the files of the Social Security Office of Paris. The patients were in from different hospitals and were treated by different surgeons between 1947 and 1954. A visual acuity of 1/10 was considered to be enough to make a person visually independent and able to use vision for work. In 243 persons the visual acuity was found to be less than 1/10. The comparatively unfavorable result is ascribed to the severity of the cases registered and to the low standard of living of the subjects.

Alice R. Deutsch.

Onfrey, Michel. **The vascular index of the retina in retinopathy and uveitis.** Bull. et mém. Soc. franç. d'opht. **68**:331-341, May, 1955.

The retinal circulation depends on three factors: the caliber of the vessels, their pulsation and the vascular tension. The retinal index expresses the relationship between the diameter of the disc and main artery and main vein, respectively. A method to take those measurements is described and the diagnostic results of the measurements in the course of retinal and choroidal diseases is demonstrated in a series of tables. (7 tables)

Alice R. Deutsch.

Ourgaud, A. G. and Bérard, P. V. **Retinal detachment and ocular hypertony.** Bull. et mém. Soc. franç. d'opht. **68**: 384-391, May, 1955.

Changes in ocular tension is one of the interesting problems in the pathogenesis of idiopathic retinal detachment. Fluorescein disappears more slowly from the anterior chamber when the retina is detached. This type of eye is usually hypotonic and after successful surgery the elimination of fluorescein and the ocular tension return to normal. It is also known that after unsuccessful surgery and cases of retinal detachment of poor prognosis the Tyndall phenomenon becomes visible in the anterior chamber as a sign of an increased permeability of the blood-aqueous barrier. Impairment in the production of aqueous and reduction of the coefficient of the resistance to the outflow of aqueous have also been described in cases of retinal detachment. Two cases of chronic glaucoma and retinal detachment and the difficulties in their therapeutic management are discussed. In the third case observed the detachment occurred after the use of DFP. The patient was a 71-year-old aphakic woman with very high ocular tension. The detachment was refractory to every kind of treatment. The poor prognosis of the occasional cases of retinal detachment following the use of DFP is stressed.

Alice R. Deutsch.

Pau, Hans. **Etiology of idiopathic retinal detachment.** Klin. Monatsbl. f. Augenh. **128**:568-573, 1956.

Two eyes with a recent detachment could be examined histologically. The degenerated areas in the retina proved to be thinned retina in which true retinal elements were replaced by vascular connective tissue and pigment epithelium. To the peripheral and the posterior margin of this "sclerotic area" vitreous strands were attached. The tear occurs at the posterior margin of the sclerotic area. (9 figures, 7 references)

Frederick C. Blodi.

Paufique, L. and Moreau, P. G. **The tension in the retinal artery in isolated orthostatic cerebral hypotension.** Bull. et mém. Soc. franç. d'opht. **68**:213-219, May, 1955.

Isolated orthostatic hypotension is frequently not recognized; the diagnosis is especially difficult when it occurs without general hypotension. Vague headaches, occipital or retrobulbar, dizziness and fainting spells are the usual complaints and they are referred to a neurovegetative imbalance if no organic lesions are found. Retinal hypotension may occur at any age. Debilitating diseases, surgery, menopause, and trauma seem to be precipitating factors. The fundi do not show any abnormal changes. Ophthalmodynamometry reveals the low retinal pressure which reaches normal values as soon as a reclining position has been taken. Intravenous injection of distilled water is the treatment of choice. Camphor and strophanthus have also been suggested. The pathogenesis of this syndrome is not clear. There is apparently no connection with a hyperexcitability of the carotid sinus.

Alice R. Deutsch.

Pillat, Arnold. **The aging of the retina.** Tr. Am. Acad. Ophth. **60**:206-209, March-April, 1956.

The author describes the senile changes in the pigmented epithelium, rods and cones, retinal parenchyma, membrana limitans interna, macula lutea, and vessels of the retina. He also considers concretions and pigmentation of the retina.

Theodore M. Shapira.

Renard, G. and Brégeat, P. **Retinal angiomatosis (localized and incomplete varieties).** Bull. et mém. Soc. franç. d'opht. **68**:239-247, May, 1955.

Seven cases of atypical vascular anomalies of the retina are reviewed. Attention is called to the fact that these localized vascular anomalies of the retina can be associated with vascular anomalies of the brain, viscera and skin. Glial proliferation on the disc with dilated, tortuous veins may assume the appearance of papilledema. Progressive changes in the appearance of the disc also may cause functional loss of the optic nerve fibers.

The importance of recognizing the congenital and developmental anomalies of the vessels in the retina was emphasized by A. Dollfus. He cited seven case histories of patients with serious neurological disturbances and localized vascular anomalies of the retina. (4 figures)

Alice R. Deutsch.

Schiff-Wertheimer, S., Gaillard, G. and Figueroa, R. **Statistical study of 176 cases of retinal detachment treated by scleral resection.** Arch. d'opht. **15**:830-838, 1955.

In 122 of 176 cases the scleral resection was the first operative procedure; in 54 cases the procedure followed previous diathermy coagulation. Success was achieved in 73, or 41 percent, of the 176 cases, partial success in 25, or 14 percent, and failure in 78, or 44 percent. In the 122 cases in which scleral resection was the first procedure, success was achieved in 61, or 50 percent; in the 54 cases in which the operation was a secondary procedure, 12, or 22 percent, turned out successfully. The series is further analyzed according to age, etiology, previous refractive error, and occurrence of operative complications. The indications for the operation are discussed and the authors conclude that it is a most valuable procedure but should be reserved for difficult and severe cases, or cases in which other procedures have failed.

P. Thygeson.

Sebas, Rafael. **Considerations about retinoblastoma.** Rev. brasil. oftal. **15**:63-68, March, 1956.

The author gives a complete review of the histopathology of the retinoblastomas. The author defines the three classical clinical stages of amaurotic cat eye, invasion of the vitreous with glaucoma and cataract, and finally complete disintegration of the globe with metastasis. After reviewing the therapy and the differential diagnosis the author suggests that intraocular aspiration of the tumor be performed routinely as a differential diagnostic measure in order to prevent unnecessary enucleations in cases of pseudoglioma. (4 references)

Walter Mayer.

Taulitz, Wilhelm. **206 retinal detachment operations.** Klin. Monatsbl. f. Augenh. **128**:473-479, 1956.

In this study 198 operations were evaluated; the retina was reattached in 106, and detached in 81. In 11 eyes a peripheral, partial detachment remained Only the diathermy coagulation method was used. Among 44 eyes with complete detachment 13 were cured and 10 out of 19 aphakic detachments were successfully operated on. (5 figures, 7 tables, 11 references)

Frederick C. Blodi.

Urrutia, D., Bitran, D., Bonnefoy, J. and Pinto, C. **Diabetic retinopathy.** Arch. chil. de oftal. **12**:153-161, Aug.-Dec., 1955.

This is a statistical analysis of the eye

manifestations in 433 diabetic patients. The authors present many tables and reach the conclusion that among all these patients, 36 had diabetic retinopathy grade two, according to Ballantynes classification, with microaneurysms, hemorrhages and exudates. Only six of these patients had complications like retinitis proliferans or glaucoma. The authors feel that the incidence of diabetic retinopathy is related to the severity and duration of the diabetes. (10 tables)

Walter Mayer.

Valenzuela, R. **Angioid streaks.** Arch. chil. de. oftal. **12**:162-165, Aug.-Dec., 1955.

The author presents a case of angioid streaks and reviews the history, etiology and pathology of this disease. (23 references)

Walter Mayer.

Wagner, Henry P. **Diseases of the retina and optic nerve.** A.M.A. Arch. Ophth. **55**:699-746, May, 1956.

The literature for 1955 is abstracted and reviewed. (366 references)

G. S. Tyner.

Weintraub, D. H. and Tabankin, A. **Relationship of retrolental fibroplasia to oxygen concentration.** J. Pediat. **49**:75-79, July, 1956.

Of 49 permature infants who were exposed to concentrations of oxygen greater than 60 percent for 30 days and then abruptly removed, 17 developed partial and 8 complete retinal detachment. When oxygen therapy was reduced to minimal needs retrolental fibroplasia disappeared from the service. Irwin E. Gaynon.

12

OPTIC NERVE AND CHIASM

Brihaye-Van Geertruyden, M. **Treatment of acute unilateral retrobulbar neuritis by repeated retrobulbar injections of hydrocortisone.** Arch. d'opht. **16**: 274-282, April-May, 1956.

The author reports in detail the case of a 47-year-old man who developed a unilateral retrobulbar neuritis accompanied by severe frontal headache and pain on movement of the eye. The neuritis was preceded by an acute rhinitis. There was no history of exposure to any toxic substances. Vision in the eye was reduced to 0.1 and there was a relative central scotoma with loss of color vision. Treatment, consisting of cortisone by mouth, was followed by aggravation of the condition, whereas retrobulbar injections of hydrocortisone, every second or third day from the eighth day, led to rapid improvement. A complete return to normal took place. General physical and neurologic examination showed no abnormalities during the course of the ocular disease.

P. Thygeson.

Carroll, F. D., Henderson, J. W., Zimmerman, L. E., Walsh, F. B. and Rucker, C. W. **Symposium: diseases of the optic nerve.** Tr. Am. Acad. Ophth. **60**:8-98, Jan.-Feb., 1956.

The contributors to this symposium selected the important data and concepts concerning the optic nerve, so thoroughly condensed and organized them, and display the material so perspicuously that a wealth of information and its significance is readily available for reference and study. Aside from the many references which record the origin of the authors' data there is a bibliography of 78 items. (40 figures, 1 table, 185 references)

Theodore M. Shapira.

Ferreira, Luiz Enrico. **Atrophies of the optic nerve.** Rev. brasil. oftal. **15**:69-93, March, 1956.

After reviewing the different symptoms which the optic atrophy may show clinically, such as a decrease in visual acuity, disturbances of the visual field, increase in the size of the blind spot, retroorbital pain on motion of the globe, pupillary

changes and pallor of the optic disc, the author also emphasizes his opinion that a decrease in the vascularization of the optic disc is a valuable indication of the severity of the optic atrophy. He reviews briefly the main types of optic atrophy according to their ethiology. He makes two large groups in his classification, 1. of atrophies with clearly outlined disc margins and 2. of atrophies with discs the margins of which are not clearly outlined. (18 references) Walter Mayer.

Thiebaut, M. F. and Matavulj, N. **Concerning some varieties of stasis of the papilla not due to tumors.** Arch. d'opht. **15**:813-829, 1955.

The authors report six cases of stasis of the papilla and analyze the etiologic and therapeutic problems involved. Fundus photographs in black and white document each case. In four of the cases, neurosurgical intervention established the nontumoral nature of the disease; in the other two, tumor formation was ruled out by prolonged observation. Each case was analyzed according to 1. appearance of the papilla, 2. relationship of the papilledema to increased intracranial pressure, 3. modifications of the electroencephalogram, and 4. other clinical signs. A distinction is made between stasis of the papilla due to obstruction of the venous circulation and papilledema in which venous obstruction may not be found.

P. Thygeson.

13

NEURO-OPHTHALMOLOGY

Erdbrink, Wayne L. **Subclinoid aneurysm of the internal carotid artery.** A.M.A. Arch. Ophth. **55**:886-887, June, 1956.

A case of a subclinoid aneurysm of the internal carotid artery in a 20-year-old patient is reported. It is of interest because of the presence of an isolated abducens palsy for seven years. The patient had been operated upon for strabismus before the diagnosis was made and later was improved by having a ligation of the artery. (1 figure, 5 references)

G. S. Tyner.

Harris-Jones, J. N. **Ocular nerve palsies with headache in diabetes mellitus.** Diabetes **5**:128-129, March-April, 1956.

The association of unilateral headache, presumed to be due to involvement of the trigeminal nerve, associated with paralysis of the sixth and third cranial nerves are reported in three cases. In one case the gradual onset suggests a neural rather than a vascular abnormality. The prognosis is excellent; all patients recovered within four months. (10 references)

Irwin E. Gaynon.

Kroll, F. G. **Importance of ocular signs in the diagnosis of brain tumors.** Arch. chil. de oftal. **12**:132-143, Aug.-Dec., 1955.

The author tabulated the eye findings in 125 cases of brain tumor. Papilledema was present in 25 percent of tumors of the hypophysis and in 10 percent of those of the fourth ventricle. Only 61 percent of all patients had papilledema. The author believes that papilledema is most frequent in tumors of the frontal lobe and of the posterior fossa. In tumors of the hypophysis it occurs only when there is a close relationship between the tumor and the optic nerve. In 50 percent of the cases there is a disturbance of the pupillary light reflex but this and anisocoria do not have a localizing value. Only in cases of fronto-temporal tumors may the anisocoria have a localizing value. In 20 percent of his cases there existed a disturbance of the extrinsic muscles. Bilateral muscle palsies offer the greatest localizing value; they are due to tumor which directly or indirectly irritates the nuclear region.

Nystagmus lacks localizing values and photopsias or visual hallucinations are psy-

chic phenomena and cannot be evaluated objectively. (3 figures) Walter Mayer.

Mazzi, L. **Radiologic aspects of Arnold-Chiari syndrome.** Riv. oto-neuro-oftal. **33**:191-208, May-June, 1955.

Two cases of Arnold-Chiari syndrome are presented, one associated with a basilar defect, the other representing a classical case. Emphasis is placed on the utilization of radiographic study of the brain in reaching an exact diagnosis, particularly in those cases with an absence of bony changes in the cranial-cervical region. (8 references)

William C. Caccamise.

Morone, G. **Investigation of the pupillary manifestations of senility.** Riv. oto-neuro-oftal. **33**:209-222, May-June, 1955.

By means of pupillography the author investigated iris dynamics in old age. On the basis of his observations he concluded that the pupillary changes in senility can be ascribed to a decrease in the tonus of the neuro vegetative system. In rare cases these pupillary changes can result from alterations in the tissue of the iris. (3 references)

William C. Caccamise.

Schweitzer, A. **Ophthalmological aspect of tumors of temporal lobe.** Arch. chil. de oftal. **12**:147-149, Aug.-Dec., 1955.

The author feels that among the homonymous hemianopsias, the superior homonymous quadrantopsia has a very high degree of localizing value in tumors of the temporal lobe. He relates the case of a patient with severe headaches, rigidity of the neck, diplopia and loss of libido. Fundoscopic examination revealed a marked papilledema. The patient had a left homonymous hemianopsia, with greatest involvement in the upper quadrants. The author felt that he was dealing with a homonymous upper left quadrantopsia due to a tumor of the right temporal lobe. At operation an oligodendroglioma of the right temporal lobe was found. The author feels that no satisfactory explanation for the production of these quadrantopsias exists as yet. (5 references, 2 figures) Walter Mayer.

Spadavecchia, V. **Further contribution to the recognition of nasociliary neuritis. II. Etiology.** Riv. oto-neuro-oftal. **33**:239-254, May-June, 1955.

Two cases of nasociliary neuritis are presented by the author, one a true and the other a degenerative neuritis. Etiologic possibilities are discussed.

William C. Caccamise.

14

EYEBALL, ORBIT, SINUSES

Fuchs, Adalbert. **Simple last step of exenteratio orbitae.** A.M.A. Arch. Ophth. **55**:692-693, May, 1956.

Steps are described to prevent retraction of the tissue surrounding the orbit after exenteration. (2 reference)

G. S. Tyner.

Gerkowicz, Kazimierz. **Observation on late diagnosis of intraorbital foreign body.** Klinika Oczna **25**:137-140, 1955.

The intraorbital penetration of a metallic foreign body in a man is described. The foreign body entered the orbit through the upper lid in 1944 and was removed in 1953. The only damage occurred at the time of the initial injury. The foreign body which measured 2.5 by 2.5 cm. was removed after X-ray examination had disclosed its presence. (3 figures, 7 references) Sylvan Brandon.

Jain, N. S., Sethi, D. V. and Parkash, O. **Leonitiasis ossea.** Brit. J. Ophth. **40**:252-253, April, 1956.

A case of lion-like face is described. This chronic, sclerosing, progressive periostitis of the facial bones affected the right

orbit and lead to proptosis and displacement of the globe. The condition is painless and slowly progressive. No treatment is given. (2 figures, 1 reference)

Lawrence L. Garner.

Klabunde, E. H., Pennisi, V. R. and Pierce, G. W. **Reconstruction of the eyebrow.** Plastic Reconstructive Surgery, 17:403-405, May, 1956.

A nevus occupying approximately one fourth of the linear distance of the right eyebrow of a girl four and one-half years old, was excised, and the incision was extended laterally to create an upper eyelid flap. A Z-plasty was executed to mobilize a strip of the remaining eyebrow into the defect. (4 figures)

Alston Callahan.

Kurus, Ernst. **Giant-follicular lymphoblastoma.** Klin. Monatsbl. f. Augenh. 128:604-607, 1956.

Unilateral exophthalmus is described in a 67-year-old woman. A tumor was excised and the histologic examination revealed the correct diagnosis. X-radiation followed. (3 figures, 3 references)

Frederick C. Blodi.

Quereau, J. V. D. and Souders, B. F. **Teflon implant to elevate the eye in depressed fracture of the orbit.** A.M.A. Arch. Ophth. 55:685-691, May, 1956.

Teflon, a polytetrafluoroethylene resin, can be used successfully in reconstruction of the orbit. It is inert and does not cause an inflammatory reaction. (7 figures, 9 references)

G. S. Tyner.

Rowbotham, G. F. and Clarke, P. R. R. **Progressive exophthalmus treated by orbital decompression.** Lancet 1:403-405, April, 14, 1956.

A method of orbital decompression, is described which was used successfully in 30 cases. The exophthalmus receded in every case with complete relief of pain, adequate decompression, and a good cosmetic effect. The procedure is relatively easy to perform.

A flap is made, starting posterior to the bony orbit. The skin and temporal fascia and muscle are then reflected and a burr opening is made in the orbital plates of the sphenoid and zygomatic bones. The opening is then enlarged until the roof and lateral walls of the orbit are removed. The annulus of Zinn and the margins of the superior orbital fissure are preserved. In severe cases, the outer margin of the orbit is also removed. The periorbital fascia is now incised freely, allowing the orbital contents to bulge out. After good hemostasis is secured, the various layers are resutured. (2 figures, 13 references)

Irwin E. Gaynon.

Tanzer, Radford C. **Reconstruction of eyebrow in case of pili torti.** Plastic Reconstructive Surgery, 17:406-409, May, 1956.

A 17-year-old patient with pili torti involving complete loss of eyebrows is presented. A transplantation of hair bearing areas of the scalp to the brow area has afforded an acceptable substitute.

Alston Callahan.

Uberall, E., Schweitzer, A. and Gonzalez, J. **Intermittent exophthalmos.** Arch. chil. de oftal. 12:150-152, Aug.-Dec., 1955.

The authors present the case of a patient, excavator by profession, who felt that his left eye was coming out of the orbit, every time he bent his head. Examination revealed that, when supine, the patient had a marked enophthalmos on the left side and palpation suggested that the retro-orbital fat had disappeared. With the head bent down or with compression of his jugular vein there was a marked exophthalmos, injection of the bulbar conjunctiva, and blurring of vision.

The authors feel that the cause must have been a retrobulbar varicosity but unfortunately were not able to demonstrate it by studies with radio-opaque substances. (4 references)

Walter Mayer.

Wheeler, J. R. **Osteoma of orbit.** Brit. J. Ophth. **40**:186-187, March, 1956.

Osteoma of the orbit is relatively rare. It is a slow-growing, benign tumor arising from the periosteum and attains a rather large size; it is easily removed because it is attached by a pedicle. In the case reported the tumor arose from the wall of the ethmoid sinus and grew into the orbit. It was easily removed. (2 figures, 1 reference)

Morris Kaplan.

Whitwell, John. **Spontaneous haematoma of the orbit.** Brit. J. Ophth. **40**:250-251, April, 1956.

A spontaneous hematoma was noted in an adult without any relationship to trauma or systemic disease. The only symptoms were pain and proptosis of sudden origin. Surprisingly, no evidence of discoloration of the external tissues was noted at any time. Surgical exploration resulted in the diagnosis of encysted blood between the superior bony wall of the orbit and the periosteum. Simple drainage was followed by complete recovery. (6 references)

Lawrence L. Garner.

15

EYELIDS, LACRIMAL APPARATUS

Duverger and Marsat. **Trepanation with a dental burr in dacryocystorhinostomy.** Arch. d'opht. **16**:165-168, 1956.

Duverger and Marsat discuss the various methods employed in producing and enlarging the bony opening in the superior maxilla in dacryocystorhinostomy. They favor the spherical burr commonly employed in otology which is listed as No. 17. They consider that the burr must be turned at four to five thousand times per minute and cooled by a fine stream of water. The technique of the operation is then discussed and is illustrated. (3 figures)

P. Thygeson.

Gemolotto, Gugielmo. **Prolapse of the palpebral portion of the lacrimal gland.** Arch. di ottal. **60**:74-78, Jan.-Feb., 1956.

A tumefaction of the outer upper quadrant of the bulbar conjunctiva which had existed for one year turned out to be a portion of the lacrimal gland. (2 figures, 2 references)

John J. Stern.

Khazarov, Y. **The prevention and operative treatment of symblepharon with the aid of an elastic layer.** Vestnik oftal. **2**: 28-30, March-April, 1956.

Khazarov placed rubber from fine surgical gloves between the raw surface of the lid and the eyeball in eye burns. Nine patients with severe burns (third degree) of the eye regained the mobility of the eyeball with marked improvement of vision. The technique of the operation is described. This method is recommended for the prevention of symblepharon in fresh burns and also in old burns when the eyeball is preserved. (2 figures, 1 table)

Olga Sitchevska.

Sidi, E. and Mawas, E. **Statistical analysis of lid ezema.** Bull. et mém. Soc. franç. d'opht. **68**:480-490, May, 1955.

In the presence of lid eczema a strict laboratory study is essential. The existence of the primary allergen, of group sensitization and of crossed sensitization should be established. The possibilities of adequate replacement in drug allergy should be investigated, especially in view of possible future surgery. The importance of this benign local disease for the general health and mental balance

of the individual should be recognized. Cortisone and hydrocortisone were found to have only a very temporary effect and do not offer any kind of protection. (3 tables, 28 references)

Alice R. Deutsch.

Starkiewicz, Witold. **Results of conjunctivo-dacryocystostomy.** Klinika Oczna **25**:123-127, 1955.

In cases of epiphora due to obstruction of lacrimal canaliculi the author recommends surgical connection of the conjunctival sac with the lacrimal sac. The technique is described. Of eight patients operated upon with this technique six had good functional results. However, in only three cases was observation longer than one year. (1 table, 18 references)

Sylvan Brandon.

16

TUMORS

Badtke, G. **Difficulties in the diagnosis of intraocular malignant tumor.** Klin. Monatsbl. f. Augenh. **128**:526-544, 1956.

Twelve cases are described in which the clinical diagnosis of a malignant uveal tumor could not be substantiated. Eleven eyes were enucleated and a uveal hemangioma was found in five, a massive subretinal hemorrhage in one, connective tissue beneath the retina in three, a tuberculoma in one and a retinal detachment with melanosis in the eleventh eye. The twelfth eye was found to have an intraocular foreign body with a connective tissue reaction around it. (14 figures, 23 references) Frederick C. Blodi.

Eoche-Duval, L., Hervouet, F. and Lenoir, A. **Intrachoroidal meningioma, a diagnostic problem.** Bull. et mém. Soc. franç. d'opht. **68**:324-330, May, 1955.

Intra-orbital meningioma is usually secondary and the extension of a primary intracranial growth. A 10-year-old girl had been under observation because of a huge white mass which covered the posterior pole of a microphthalmic eye. The mass was considered to be inflammatory and the eye was checked at regular intervals. After a large detachment developed, enucleation was advised and the eyeball was removed. The pathologic examination showed an intrachoroidal mixed-cell meningioma with many psammoma bodies which was continuous with a similar tumor of the optic nerve sheath. The optic nerve was cut through the tumor mass during enucleation. On X-ray examination new-formation of bone was visible over the small wing of the pterygoid. Intracranial exploration was rejected by the parents. There were no local recurrences in the orbit during the next two years. An intraocular origin of the meningioma was thought to be a possibility. (9 figures) Alice R. Deutsch.

Frayer, William C. **An eye with endothelial dystrophy and multiple malignant melanomata.** A.M.A. Arch. Ophth. **55**: 807-812, June, 1956.

This report consists of a clinical and histopathologic study of an eye containing two apparently independent malignant melanomata and showing pathologic changes in the cornea consistent with the diagnosis of endothelial dystrophy. A study of the literature indicates that such cases are rare. (6 figures, 14 references)

G. S. Tyner.

Gemolotto, Guglielmo. **Reticulo-histiocytoma of the ocular adnexa.** Arch. di ottal. **60**:45-58, Jan.-Feb., 1956.

Two cases of tumors of the reticulo-endothelial system of the lids and one of the conjunctiva are described. (3 figures, 30 references) John J. Stern.

Hoffmann, W. **Small melanomas in chronically irritated eyes.** Klin. Monatsbl. f. Augenh. **128**:544-549, 1956.

In three enucleated eyes a malignant melanoma was incidentally found. A choroidal melanoma was found in the eye of a 47-year-old woman who had a severe intraocular infection after a fall. The eye had been operated on 43 years previously because of a zonular cataract. A melanoma of the ciliary body was found in the atrophic eye of a 43-year-old woman with Sturge-Weber disease. A marked proliferation of pigment epithelium was found in the eye of a 43-year-old man who had had two cataract operations as an infant. (4 figures, 7 references)

Frederick C. Blodi.

Valiere-Vialeix, Chassaing, Cellier and Robin, A. **A case of retinal glioma of unusual structure.** Bull. et mém. Soc. franç. d'opht. **68**:262-275, May, 1955.

Retinal gliomas in adults are very rare and only a few cases have been described in pathological slides after the eyes were enucleated because of late intercurrent complications. Never before has a similar tumor been seen ophthalmoscopically in an early stage. The lesion in question was found on routine fundus examination in a 45-year-old man. It is described as a very sharply outlined, very white, round and slightly raised tumor between macula and disc. The tumor increased rapidly in size and therefore the eye was enucleated. It originated in the internal layer of the retina, infiltrated all layers up to the choroid and encroached on the optic nerve. It was not encapsulated but sharply outlined. The tumor cells consisted of astrocytes and microglia with exaggeration of glial fibers on the inner side. The inside of the tumor showed an accumulation of calcospherites. The vessels were scarce and partly hyalinized. It was the calcification which led to the preliminary diagnosis of meningioma. The differential diagnosis between a typical retinal glioma and other retinal tumors is outlined. (4 figures, 20 references)

Alice R. Deutsch.

17

INJURIES

Tulloh, C. G. **Migration of intra-ocular foreign bodies.** Brit. J. Ophth. **40**:173-177, March, 1956.

The retention and migration of foreign bodies within the eye has been reported often. Most of the particles are of copper; it is non-magnetic and they are usually retained. Glass and iron do not usually move within the eye. Movement is little affected by the size or shape of the particle and it is always forward and a little downward. A case is described in which a copper particle $4 \times 1.25 \times 1$ mm. entered through the cornea and could not be removed in two attempts. Two and one half years later it migrated forward and through the sclera near the limbus, where it was easily removed. (3 figures, 20 references)

Morris Kaplan.

18

SYSTEMIC DISEASE AND PARASITES

Appelmans, M., Michiels, J. and Missotten, L. **Cataract and other ocular complications of the pulseless syndrome.** Arch. opht. **16**:5-11, 1956.

The pulseless disease, or syndrome of Takayasu, has been known since 1908. It is due to a progressive thrombosis of the subclavian and carotid arteries, the cause of which is not yet established. The authors present a case report of this syndrome in a man of 44 years who had grave eye complications consisting of extensive vascular changes in all parts of the eye, low visual acuity, calcium deposits in the corneas, hyalin bodies on Descemet's membrane, atrophic irises, and cataract, total in the right eye, partial in the left. Both pupils were in mydriasis and barely reacted to light.

In their discussion the authors conclude that this patient presented the disease's characteristic triad of symptoms: 1. absence of radial pulse, 2. vascular changes in the fundi, and 3. cataract. They discuss the various theories of etiology, including the tuberculous, syphilitic, allergic, and collagenous theories, and the theory of the hypercoagulability of the blood. Their conclusion is that the cause is still unknown. They note that the ocular complications of the disease dominate the clinical picture. From their review of the literature they conclude that blindness is the inevitable result of the disease. P. Thygeson.

Boase, A. J. **Coenurus cyst of the eye.** Brit. J. Ophth. **40**:183-185, March, 1956.

Coenurus cyst is a developmental stage of Multiceps multiceps which is a comcon parasite in dogs. The dog becomes infested by eating brains of infested sheep. The parasite has occurred in man but its occurrence in the eye has not been made known. Two cases are now reported of such cyst infestation in one of which the cyst was within the eye and in the other beneath the conjunctiva. (3 figures, 2 references) Morris Kaplan.

Guendet, J. F., Miescher, P., Pitter, O. and Sigard, C. **Recurrent venous thrombosis in ophthalmology.** Bull. et mém. Soc. franç. d'opht. **68**:254-266, May, 1955.

Recurrent venous thrombosis mostly affects the lower extremities and often is referred to a hypersensitivity of this localized venous system towards an area of focal infection. Analogous afflictions of the retinal veins are a rarity.

A detailed case history of a 43-year-old man with recurrent thrombosis of the retinal veins was reviewed. He had a past history of frequent multiple infections, mild polycythemia, thrombophlebitis of the legs, hypersensitivity to penicillin and pronounced sensitivity to O.T. (1/1000). In spite of the positive Mantoux test a tuberculous etiology of the eye disease was not considered because of a normal sedimentation rate, a negative history and the lack of improvement after chemotherapy (P.A.S. and stretomycin). Two theories of the pathogenesis of recurrent venous thrombosis have been established. (10 references)

Alice R. Deutsch.

Kennedy, R. J. and Green, M. F. **Unilateral exophthalmus as the presenting sign in leukemia; report of two cases.** Cleveland Cl. Quart. **23**:133-138, April, 1956.

Unilateral exophthalmus rarely occurs as the presenting sign in leukemia. In the cases presented it was intermittent in one and constant in the other. Exophthalmus is present in two percent of patients with leukemia. Patients with unilateral exophthalmus should have accurate and complete studies of blood and bone marrow, which may obviate unnecessary orbital exploration. (2 figures, 2 tables, 13 references) Irwin E. Gaynon.

Kimura, H. **A fundamental study of tuberculosis of the eye, IV-V.** Acta Soc. Ophth. Japan **60**:363-380, May, 1956.

About 5 percent of patients in sanitaria have a history of phlyctenule and another 2.7 percent a history of other ocular tuberculosis. A test of lactic acid coagulation is of a greater value than the blood sedimentation rate in the diagnosis of ocular tuberculosis. (23 tables, 57 references) Yukihiko Mitsui.

Smolik, H. **The oculo-urethro-synovial syndrome.** Rev. Med. Suisse Romande **76**:713-721, June, 1956.

The author discusses frequence and occurrence of Reiter's syndrome as well as the clinical manifestation, diagnosis, prognosis, etiology and therapy. (18 references) F. H. Haessler.

Somerset, E. J. and Sen, N. R. **Leprosy lesions of the fundus oculi.** Brit. J. Ophth. **40**:167-172, March, 1956.

Leprosy of the eyes occurs much less often in the eye than in other organs, and a lesion in the fundus is extremely rare. Leprosy of the eyes is less common in Bengal Province of India than in many other parts of the world. The authors describe two cases of leprotic retinitis occurring in relatively young people who had had general leprosy for at least 25 years. The first case was discovered in the 108th leprosy patient examined and the second in the 224th patient. Both presented several round, discreet, yellowish nodules in the periphery of the retina which seemed to be identical with similar nodules in the iris. Most of these cleared under general leprotic treatment. Neither patient had ocular symptoms from the retinitis whereas symptoms from lesions in other parts of the eye are quite common. (3 figures, 21 references)

Morris Kaplan.

Swan, C. and French, E. **A case of toxoplasmosis.** M. J. Australia **1**:1009-1011, June 16, 1956.

The authors report a case of congenital toxoplasmosis in an infant and provide a short review of the reports on the value of the various serological tests. (15 references) Hugh Ryan.

19

CONGENITAL DEFORMITIES, HEREDITY

Gregg, Sir Norman. **Congenital anomalies due to maternal infections, especially in the early months of pregnancy.** Tr. Am. Acad. Ophth. **60**:199-205, March-April, 1956.

The author mentions rubella, mumps, smallpox, varicella, poliomyelitis, influenza, infective jaundice, and herpes zoster; he deals chiefly with rubella and speaks of only two ocular defects: cataract and retinopathy. (1 table, 16 references)

Theodore M. Shapira.

Hertzberg, R. **Tay-Sachs disease: report of three cases in one family.** Med. J. Australia **1**:664-665, April 21, 1956.

Infantile amaurotic idiocy is almost exclusively confined to Jewish children. The late infantile and juvenile forms are not restricted to any particular race. Consanguinity of parents is common. The condition is regarded as a recessive characteristic, but this is by no means fully established. In the three reported cases the only Jewish blood came from the paternal great-grandfather. (7 references) Hugh Ryan.

Rieger, H. **Advances in genetics.** Klin. Monatsbl. f. Augenh. **128**:513-526, 1956.

This is a review article in which a few of the hereditary ocular diseases are discussed. The various theories of the heredity of refractive anomalies (Steiger, Lindner) are mentioned. Retinal detachment, retinoblastoma and color blindness are cited. Frederick C. Blodi.

Sorsby, A., Savory, M., Davey, J. B. and Fraser, R. J. L. **Macular cysts: a dominantly inherited affection with a progressive course.** Brit. J. Ophth. **40**:144-158, March, 1956.

The macular cysts which occurred in two generations in three families and in three generations in two families are described in detail and with very clear illustrations of each fundus. The disease undoubtedly is transmitted in simple dominant inheritance. It is congenital and progressive and although it seems to be mild at first, it leads to destruction of central vision after middle age. This cyst is what has probably and frequently been described as a hole in the macula and a hole can actually occur upon rupture of the cyst. (10 figures, 1 table, 15 references) Morris Kaplan.

Streff, E. B., Rosselet, E. and Jequiel, M. **Progressive facial hemiatrophy (Rom-**

berg's syndrome) and coloboma of the uvea. Bull. et mém. Soc. franç. d'opht. **68**:207-212, May, 1955.

The patient was a 22-year-old Italian. He presented an interesting combination of a late degenerative process (Romberg's syndrome) with a congenital anomaly (bilateral uveal coloboma). In addition to the hemiatrophy which became noticeable when the patient was 21 years old and the uveal coloboma, he had the signs of a low grade uveitis suggestive of Fuchs' heterochromia except that it was present in both eyes. The general physical examination was negative with exception of a spina bifida at the level of the second sacral vertebra. The factors in favor of a genetic etiology of progressive facial atrophy are outlined and each factor individually evaluated. (1 figure)

Alice R. Deutsch.

Uribe, A. **A case of Crouzon's disease.** Arch. chil. de oftal. **12**:166, Aug.-Dec., 1955.

The author presents a typical case of craniofacial dysostosis and describes the radiographic findings of the face and skull. Walter Mayer.

Vogel F. and Balthaser, G. **Identical twins with congenital nystagmus and myopia.** Klin. Monatsbl. f. Augenh. **128**: 456-459, 1956.

Two 12-year-old boys were examined. Myopia was present in the father and his family. (13 references)

Frederick C. Blodi.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Byrnes, V. A., Brown, D. V. L., Rose, H. W. and Cibis, P. A. **Chorioretinal lesions due to thermal radiation from the atomic bomb.** A.M.A. Arch. Ophth. **55**: 909-914, June, 1956.

Some of the exhibits of chorioretinal lesions due to thermal radiation from the atomic bomb which were a part of the American Medical Association Exhibits in 1955 are here reproduced and discussed. (19 figures) G. S. Tyner.

Chalvignac, A. **The "oculists" of Dades.** Arch. d'opht. **16**:283-291, April-May, 1956.

Chalvignac has studied in southern Morocco the native "oculists" and was able to gain the confidence of some 15 of them. The village of Ait Bou Youssef was particularly noted for its "oculists" who, as itinerant operators, cover all of southern Morocco and extend their activities even into Tunisia, Algeria, Tripoli, and Egypt. In Morocco these practitioners have been well tolerated but they are liable to arrest for the illegal practice of medicine in the other countries. The profession is hereditary and the son begins his apprenticeship at the age of 10 by assisting his father. At 18 he begins to do his first couching operation under parental supervision and soon thereafter becomes independent.

The author was able to examine a number of surgical kits and lists the instruments, many of them of local manufacture. A scissors is used to scarify the trachomatous conjunctiva, and stylets to couch cataracts. Before use the instruments are washed but not sterilized. The interventions on the globe undertaken by these practitioners have included cataract surgery, glaucoma surgery, and evisceration; on the adnexa they have included surgery for trichiasis, pterygium, and disorders of the lachrymal apparatus. A number of photographs of the operations are included in the report.

P. Thygeson.

NEWS ITEMS

Edited by Donald J. Lyle, M.D.
411 Oak Street, Cincinnati 19, Ohio

News items should reach the editor by the 12th of the month. For adequate publicity, notices of postgraduate courses and meetings should be received three months in advance.

Announcements

Call for papers

The 1957 meeting of the Section on Ophthalmology, A.M.A., will be held in New York, June 3 to 7, 1957, simultaneously with that of the Association for Research in Ophthalmology.

Anyone wishing to present a paper before the section is urged to communicate with Dr. Harold G. Scheie as soon as possible. A title and abstract of 50 to 150 words must be in his hands by January 1, 1957. Anyone wishing to present a paper before the Association for Research should contact Dr. Lorand V. Johnson as soon as possible.

Harold G. Scheie, Secretary
Section on Ophthalmology
313 South 17th Street
Philadelphia 3, Pennsylvania

Lorand V. Johnson, Secretary
Association for Research in Ophthalmology
10515 Carnegie Avenue
Cleveland 6, Ohio

Surgery of the cornea

Surgery of the cornea will be offered as a full-time course by the New York University Post-Graduate Medical School from December 3rd through 7th.

Given under the direction of Dr. Ramon Castroviejo, the course is designed to cover thoroughly the current concepts and practices in the field of corneal surgery by means of lectures, observation of surgical procedures in the operating room, and practice on animal eyes.

Surgery of the cornea is one of 11 courses offered by the Post-Graduate Department of Ophthalmology during the academic year. For further information write to:

The Dean
Post-Graduate Medical School
550 First Avenue
New York 16, New York

Plastic surgery

An intensive integrated course in ophthalmic plastic surgery for a limited number of applicants will start on November 1st and continue for the month of November, five days a week, at the New York Eye and Ear Infirmary. Instructors for the course are Dr. Wendell L. Hughes, Dr. Byron C. Smith, Dr. Gordon Cole, and Dr. Peter Ballen. There will be lectures, movies, discussion of techniques, demonstration of cases, and assistance in the operating room on actual cases. The fee for the course is $100.00. For registration write:

Mrs. Mabel Stewart
Post-Graduate School
New York Eye and Ear Infirmary
218 Second Avenue
New York, New York

Congress of neurological sciences

The First International Congress of Neurological Sciences will be held in Brussels, Belgium, July 21 to 28, 1957. This congress is an affiliation, for the first time, of all independent international congresses of several neurologic disciplines into a single integrated international convention.

The congresses scheduled to meet simultaneously in Brussels under the new co-ordinated program are: Sixth International Neurological Congress, Fourth International Congress of Electroencephalography and Clinical Neurophysiology, Third International Congress of Neuropathology, First International Congress of Neurological Surgery, Third meeting of the International League Against Epilepsy, and second symposium Neuroradiologicum. The broad title of Congress of Neurological Sciences was adopted to allow for participation in future congresses of other neurologic disciplines, such as neuroanatomy, neurochemistry, and neuropharmacology.

The scientific program of the International Congress of Neurological Sciences will highlight two major symposia of common interest to the congress as a whole, and several symposia of special interest to the particular disciplines represented by each affiliate of the congress, but which are pertinent to the interests of the entire congress. In addition, arrangements have been made for the presentation of miscellaneous communications.

The two major symposia of common interest are: "Extrapyramidal disease" to be conducted by Prof. Raymond Garcin of Paris and the "Significance and interpretation of modifications of the conscious state" by Sir Geoffrey Jefferson of London. Among the symposia of special interest is one on "Multiple sclerosis" under the chairmanship of Prof. H. Houston Merritt of New York, vice-president of the United States Committee of the Sixth International Neurological Congress.

The organization of the First International Congress of Neurological Sciences is centralized under the direction of Prof. P. van Gehuchten and Dr. Ludo van Bogaert, president and secretary-general of the Belgian National Committee for the Sixth International Neurological Congress.

Appointed as official travel agencies are Thomas

Cook and Son, Inc., and the American Express Company.

As the program develops, further information may be obtained from Dr. Pearce Bailey, secretary, Committee for the United States of the Sixth International Neurological Congress, National Institutes of Health, Bethesda 14, Maryland.

Residency available

An ophthalmology residency is immediately available for a term ending June 30, 1959. The candidate must be a United States citizen, a graduate of an American medical school, and have completed at least one year of council-approved internship. The salary is $2,848.00 for the first year, with regular increases. It is an active general medical and surgical hospital of 1350 beds. For details write:

Dr. Abraham S. Haft
V.A. Hospital
Bronx 68, New York

Societies

Pennsylvania meeting

The seventh annual interim meeting of the Pennsylvania Academy of Ophthalmology and Otolaryngology will be held jointly with the Medical Society of the State of Pennsylvania at Haddon Hall Hotel, Atlantic City, New Jersey, Wednesday, October 24th. On the ophthalmology program will be:

A panel discussion on "Allergy." Dr. Carroll R. Mullen, Philadelphia, "Ocular insults in diabetes"; Dr. Glen G. Gibson, Philadelphia, "Surgical approach to glaucoma"; Dr. P. Robb McDonald, Philadelphia, "Vitreous syndromes"; Dr. Harold G. Scheie, Philadelphia, "A method of cataract extraction following filtering operations for glaucoma."

Miscellaneous

Leaflets available

The Pennsylvania Association for the Blind, 100 East Price Street, Philadelphia 44, Pennsylvania, announces the availability of two recently published leaflets—"Take time to see" and "Crosseyes."

Trachoma control

The government of India has sanctioned a two-year trachoma control pilot project at the Gandhi Eye Hospital and the Muslim University Institute of Ophthalmology, Aligarh. During the first year of the study, activities will be limited to a rural population of about 20,000 persons living around the Community Project Centers near Aligarh. The work will be conducted jointly by the government of India and the World Health Organization. The Indian Council of Medical Research will direct and guide the study and Dr. M. Radevanovic, medical consultant to the World Health Organization, will be the chief advisor.

Histopathology course

Dr. Bernard A. Roberts and Dr. Lawrence Samuels of the Department of Ophthalmic Pathology, New York Eye and Ear Infirmary, Dr. Brittain F. Payne, director, conducted an intensive course in histopathology of the eye, October 1st to 6th.

Personals

Dr. John C. Locke has been appointed ophthalmologist-in-chief at the Royal Victoria Hospital, and professor of ophthalmology and chairman of the department at McGill University, Montreal. He succeeds Dr. Kenneth B. Johnston, who has been appointed to the honorary consulting staff.

Dr. Derrick Vail, Chicago, has been invited to give the Doyne Memorial Lecture at the annual Oxford Ophthalmological Congress, Oxford, England, July 1 to 3, 1957.

Dr. William John Holmes, Honolulu, has recently returned from a trip to the Orient, New Zealand, and Australia. In Japan, Korea, and Okinawa, Dr. Holmes served as ophthalmologic consultant to the Office of Civil Affairs and Military Government, Department of the Army. In Australia and New Zealand, with Prof. Jules François, Ghent, Belgium, he was guest-of-honor at the annual meeting of the Australian Ophthalmological Society in Brisbane, and the annual meeting of the New Zealand Ophthalmological Society in Wellington. Dr. Holmes was made an honorary member of both of these societies.

Urgent Request

The Uveitis Laboratory, University of California School of Medicine, San Francisco, is interested to obtain freshly enucleated eyes from patients with *all types of uveitis* and other endogenous inflammations. Attempts are being made to isolate etiologic agents from these eyes.

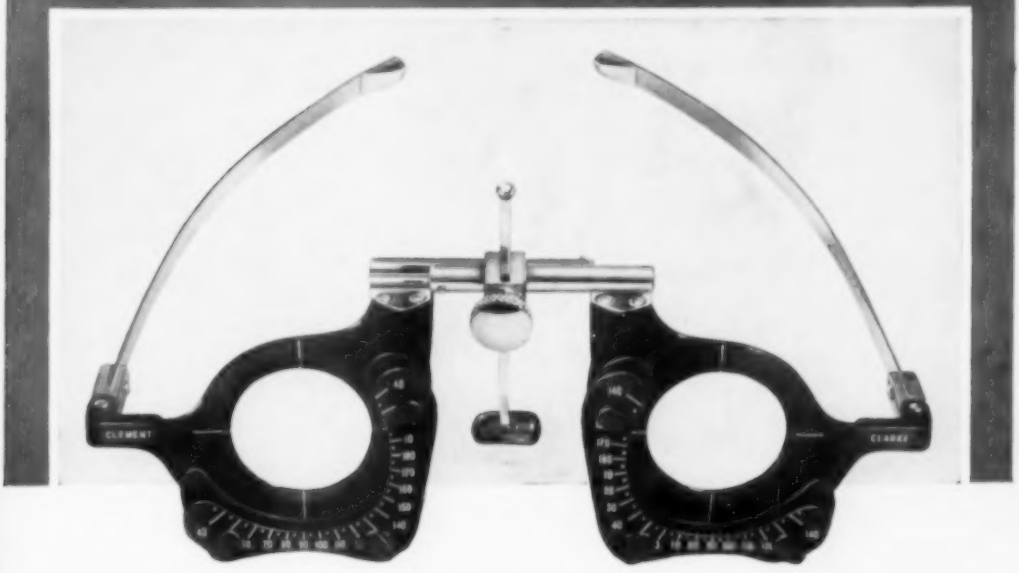
The eyes should *not* be fixed in preservatives or frozen, but placed in a sterile bottle, packaged, and shipped as quickly as possible. Please send specimens *air express, special delivery, collect.* Enclose history and findings and mark the package "Fresh Tissue Specimen—Rush."

A report of isolations of organisms and pathologic findings, including a slide, will be sent to the contributor. Credit will be given in any resulting publications if desired.

* * * *

Telegraph collect if specimen being sent. Send eyes to Samuel Kimura, M.D., Michael J. Hogan, M.D., or Phillips Thygeson, M.D., University of California School of Medicine, San Francisco 22.

Clement Clarke Present



THE SKEOCH TRIAL FRAME

This new trial frame has been designed to facilitate the ever-growing use of reduced aperture trial lenses, mounted in thin aluminium or plastic rims. The Skeoch has none of the drawbacks of many hitherto popular trial frames, and will prove to be of material assistance in refraction. It is simple, rigid, light in weight, and the comfort of the patients, including very young children, has not been overlooked. The features of the Skeoch trial frame are as follows :—

Lightness in weight (approximately 1¼ ozs.). Apart from the sides, connecting bar and nosepiece, the frame is made of an aluminium alloy noted for strength and lightness. The sides are of hardened and tempered spring steel, the connecting bar is of nickel and the nosepiece is of plastic.

Shape and finish of nasal portions of cells, enabling frame to rest comfortably on patient's nose. For young children with very small interpupillary distances the frame will support itself on the sides of the nose without the aid of the bridge.

Contour of cells enabling lenses to be inserted and withdrawn with great ease, and cylinders to be rotated by a single thumb and finger movement.

Close spacing of cells, ensuring correct positioning of lenses and the absence of large gaps between them.

Extremely accurate engraving on the axis scales ensures correct positioning of cylinders. Crossline engraving facilitates the centration of frame in relation to pupils.

Angling sides of spring steel, to allow correct positioning of frame.

Two types available. 3 cell type for refractionists with a fully comprehensive trial case from which one lens only need be selected to correct the spherical error. 4 cell type recommended for those refractionists with a standard trial case from which 2 spheres are often required.

For illustrated leaflet on other Trial Frames please write to

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When we first introduced the Executive Bifocal we quite naturally met with some skepticism.

Today we are proud of our collection of sincere and unsolicited "testimonials" from the profession, telling us why the Executive Bifocal has met with such success. Here are just a few of the many comments we have received:

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"They are the perfect solution to the trying problem of 'jump' that we have with bifocals." . . . Texas

"I have had outstanding success with the bifocal for barbers, draftsmen and accountants." . . . California

"I have instructed our staff to prescribe these lenses for virtually all multifocal purposes and the response from our clientele has been enthusiastic." . . . New York

" . . . no image jump, and they are color free, also I enjoy the wide field of vision they provide." . . . New Jersey

"I believe it to be one of the finest prosthetic aids yet to be devised for the human vision." . . . Texas

"Executive type bifocals are ideal for children who have an accommodative esotropia in which parallelism is present for distance but a small esotropia persists for near." . . . New Jersey

You too will get favorable comments from your patients when you recommend to them the Executive Bifocal, the first really different multifocal to be developed in nearly thirty years.

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